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VICTORIA'S JUBILEE.

THE so-called "Diamond Jubilee" of Queen Victoria, which commemorated the sixtieth anniversary of her accession to the throne of Great Britain, was certainly the most splendid spectacle of modern times and was the most imposing outward display of the political, social and military factors of modern civilization which the world has witnessed. It was not only a personal tribute to the aged Queen who has reigned so well, but it was a manifestation of the imperial power of this great nation. To those who believe in the great destiny of the English speaking race that already dominates so large a part of the world, this demonstration has more than national importance and is vastly sig-

THE QUEEN'S JUBILEE—ILLUMINATION OF WINDSOR CASTLE ON JUNE 18.

nificant. Victoria's reign has been concurrent with the era of greatest expansion of the English speaking race. When the long reign is carefully analyzed, it will be seen that Thiers' famous saying, "The King reigns but does not govern," is not entirely applicable in this case. Victoria has been many times instrumental in shaping policies which have redounded to the credit of England and she has steered clear of the many blunders to which monarchs are so prone. Victoria's wisdom leads her not to seek to govern so much as to guide, and her gracious presence has often moderated the asperities of party conflict. Certainly no other ruler has done so much to make a proletarian outbreak like that of the French Revolution impossible.

The celebration of the "Diamond Jubilee" began on Sunday, June 20, with the holding of thanksgiving services throughout the kingdom, and everywhere, from a huge fair. The city was magnificently dressed with flags, bunting, and other elaborate decorations, and even in the smoke soiled back streets off the line of the route could be seen little union jacks sticking out of the top corner of a broken window of some cheap tenement. The whole city had to be seen before the meaning of the Jubilee could be appreciated in the gross.

Every available nook and corner was taken up with seats for spectators. They brought fabulous prices. In some cases the sum received was sufficient to entirely rebuild the structure. These stands were built with true British solidity, so that there were no accidents whatever. Just before the Jubilee prices for seats dropped to a wonderful extent, and many of the speculators found they were ruined. One gentleman, who some weeks before had paid $5,000 for a room with two windows, found that they would not fetch over $500. Bridge Road, Westminster Bridge, Parliament Street and the Mall to Buckingham Palace. First came the Royal Horse Guards, then the colonial troops. The troops consisted of Canadian Hussars, Dragoons, and Mounted Police, New South Wales Lancers and Mounted Rifles, with their graceful felt hats and brown boots, Victorian Mounted Rifles, New Zealand Mounted Troops, Queensland Mounted Rifles, Cape Mounted Rifles, South Australian Lancers and Mounted Rifles, Natal Mounted Troops, Natal Carabiniers, Umvoti, Natal and Border Mounted Rifles, Mounted Troops of Crown Colonies, Zaptiehs from Cyprus, Trinidad Mounted Rifles, and a few Rhodesian Horse. The colonial troops were very interesting and were well received, and gave an excellent idea of England's imperial possessions; then came various portions of the Naval Brigade and the high officers of the army. The

THE QUEEN'S JUBILEE—GROUP OF ENGLISH SOLDIERS AND NATIVE COLONIAL DETACHMENTS, INCLUDING POLICE OF BORNEO, POLICE FROM CYPRUS, AND HAOUSSAS FROM THE AFRICAN GOLD COAST.

St. Paul's Cathedral to the humblest village chapel, the people met to pray for Her Majesty. A private service was held in St. George's Chapel, Windsor Castle, which was attended by the Queen and the members of the royal family. Her children embraced her after the service. Public service was held in the chapel in the afternoon, a chorus of five hundred voices giving Mendelssohn's "Hymn of Praise." A special service was held in St. Paul's Cathedral, London, in which the diplomats, special Jubilee envoys and judges in their robes of state attended.

Continuous services were held in many of the churches throughout the day. It was the strangest Sunday ever seen in London. London is ordinarily the most dreary place imaginable upon the Sabbath; so much so that Americans, at least, are always glad to get away from its depressing influence: but on this occasion the route that was to be traversed by the royal procession resembled Desirable seats cost from $25 to $150 and even more, and everything else was in proportion. The commercial aspect of the Jubilee is, perhaps, the only disagreeable feature connected with it, and it was very hard to see how it could have been avoided.

The Queen made a triumphal progress from Windsor to London, where she rested at Buckingham Palace. In the early morning of Tuesday, June 22, the great day of the royal procession dawned cloudy and still, but very shortly before the Queen's carriage became visible, in the courtyard of Buckingham Palace, the dark clouds were thinner and less ominous. The rest of the morning and afternoon was bright and sunshiny. In brief, the route of the procession was from Buckingham Palace, around Constitution Hill, down Piccadilly, St. James Street, Pall Mall, the Strand, Fleet Street to St. Paul's, then by way of Cheapside, London Bridge, Borough High Street, Borough Road, Westminster total number of troops employed in the procession as guards of honor and in lining the streets was 46,943.

Punctually at eleven the starting gun in Hyde Park was fired as a signal that the Queen had entered her carriage. Her progress toward St. Paul's Cathedral, where the colonial procession had already gone, was made with few delays. Various detachments of soldiers and representatives of the navy led the way. After the regular troops had passed came the naval and military aides-de-camp to the Queen. Then the pageant became more gorgeous than ever, the foreign naval and military attachés glittering in their many colored uniforms; ambassadors came next, and now the excitement was most intense as the Queen and her escorts appeared. Perhaps there was never assembled in public a more august body of dignitaries. There was an escort of thirty-six English and foreign princes on horseback, riding in threes; an Indian escort of twenty navy offi-

cers and cavalry regiments followed; then came the supreme moment for which the many millions had been waiting. Field Marshal Lord Wolseley, Commander-in-Chief of the British army, rode by alone, and then there were seen the cream colored horses which were famous throughout the empire drawing the carriage in which sat the sovereign. The enthusiasm knew no bounds. It could, perhaps, be described adequately by saying it was an avalanche of sound. It was difficult to believe that seventy-eight eventful years had passed over the Queen's head. Her Majesty was seated opposite the Princess of Wales and the Princess Christian. The Prince of Wales, the Duke of Connaught and the Duke of Cambridge were by her side as outriders; behind followed the royal standard, grooms and equerries. Last of all come the Royal Irish Constabulary and a squadron of the Horse Guards. When the Queen's carriage reached Temple Bar the Lord Mayor was waiting to receive Her Majesty to render official homage and to present a pearl sword of state. She spoke a few words in reply to the address of the Lord Mayor and the procession moved on to St. Paul's.

As the Queen approached St. Paul's Cathedral the Archbishops of Canterbury and York, with a numerous train of clericals, emerged from the west front and stood upon the steps, where they awaited the arrival of Her Majesty. Immediately, as the Queen's carriage was drawn up, the choir intoned the "Te Deum," after which the Bishop of London offered a prayer. The Archbishop of Canterbury then pronounced the benediction, after which the choir sang the Hundredth Psalm. This service is an interesting contrast to that which occurred when the girlish Queen had been anointed in Westminster Abbey, sixty years before. The ceremonies at St. Paul's were so interesting that we cannot refrain from giving Mr. G. W. Steevens' pen picture of the event which he gave in the Daily Mail.

"Riding three-and-three came a kaleidoscope of dazzling horsemen, equerries, aides-de-camp, attachés, ambassadors, and princes, all the pomp of all the nations of the earth—scarlet and gold, azure and gold, purple and gold, emerald and gold, white and gold—always a changing tumult of colors that seemed to list and gleam with a light of their own. It was enough. No eye could bear more gorgeousness; no more gorgeousness could there be, unless princes are to clothe themselves in rainbows and the very sun.

"The prelude was played, and now the great moment was at hand. Already carriages were rolling up, full of the Queen's kindred, full of her children and children's children; but we hardly looked at them. Down there through an avenue of eager faces, through a storm of white, waving handkerchiefs, through roaring volleys of cheers, there was approaching a carriage drawn by eight cream colored horses. The roar surged up the street, keeping pace with the eight horses. The carriage passed the barrier; it entered the churchyard; it wheeled left and then right; it drove up to the very steps of the cathedral.

"We all leaped up. Cheers broke into screams, and the enthusiasm swelled to delirium. The sun, watery until now, shone out suddenly, clear and dry, and there and there and there was a little, plain, flushed old lady, all in black, with a silver streak under her black bonnet, and with a simple white sunshade, sitting quite still, with the corners of her mouth drawn tight, as if she was trying not to cry. But that old lady was the Queen, and you knew it. You did not want to look at the glittering uniforms now, nor yet at the bright gowns and young faces in the carriages, nor yet at the stately princes, though by now all these were ranged in a half circle round her.

"You could not look at anybody but the Queen, so very quiet, so very grave, so very punctual, and so unmistakably every inch a lady and a Queen.

"It was almost pathetic, if you will, that small, black figure in the middle of these shining cavaliers, this great army, this roaring multitude, but it was also very glorious.

"When other kings of the world drive abroad, an escort rides close at the wheels of their carriages. The Queen drove through her people quite plain and open, with just one soldier at the curbstone between her and them. Why not? They are quite free. They have no cause to fear her. They have much cause to love her. Was it not all for her—gala trappings of the streets, men, horses, guns, and the living walls of British men and women? For the Queen summed up all that had gone before—all the soldiers and sailors, the big limbed colonials, and the strange men from unheard of islands over sea.

"We know now what that which had come before all stood for. We knew as we had never known before what the Queen stands for. The empire had come together to revere and bless the mother of the empire. The mother of the empire had come to do homage to the one Being more majestic than she.

"There were the archbishops, bishops and deans in gold and crimson caps and white, orange and gold embroidered vestments waiting on the steps. There, through gaps in the pillars and scaffoldings, you could see all her ministers and great men, a strange glimpse of miniature faces as in some carefully labored picture, where each face stands for an honored name.

"All stood, and the choir sang the 'Te Deum.' Next rose up a melodious voice intoning prayers. The Queen bowed her head and then the whole choir and the company outside the cathedral and the whole company in the stands, at the windows, on the housetops, and away down the street, all standing, all uncovered, began to sing the One Hundredth Psalm, 'Come ye before Him and rejoice.'

"The Queen's lips were tight, and her eyes, perhaps it was fancy, looked dim; but then 'Three cheers for the Queen!' and the dean, pious man, was wildly waving that wonderful crimson cap, and the pillars and roofs were ringing as if they must come down. Then 'God Save the Queen,' a lusty peal till you felt drowned in sound.

"The Queen looked up and smiled, and the Queen's smile was the end and crown of it all, a smile that broke down the sad mouth, a smile that seemed half reluctant, so wistful, yet so kind, so sincere, so motherly."

The colonials fell in behind the royal procession after leaving St. Paul's. A brief stoppage was made at the Mansion House by the Lord Mayor's wife, who presented a bouquet to the Queen, and here Her Majesty dispensed with the attendance of the Lord Mayor, who had accompanied her from Temple Bar. The procession then continued to London Bridge, and thence along the streets on the southern side of the Thames. It reached Buckingham Palace at 1:40 P. M., twenty minutes before the programme time. Before the return of Her Majesty to the palace, she lay down for an hour, and spent the rest of the afternoon in the garden. She bore the fatigue exceedingly well. The enthusiasm of the British people for several days was unbounded, and the splendid display of sea power—the greatest the world ever saw—on June 26, at Spithead, was the other crowning feature of this memorable occasion.

Our engravings, for which we are indebted to L'Illustration, represent the military tattoo at Windsor before the departure of the Queen, and the colonial soldiers in the procession, and the procession passing through Whitechapel.

THE QUEEN'S JUBILEE—COLONIAL TROOP PASSING THROUGH WHITECHAPEL.

INCREASE OF THE DRYING POWER OF OILS.

By A. LIVACHE.

THE principal factors which increase the power of fixing oxygen of a siccative oil such as linseed are, first, the degree of purity of the oil; secondly, the time which has elapsed since its extraction; thirdly, the conditions under which it has been kept; fourthly, heat; fifthly, the addition of certain substances.

1. The Degree of Purity of the Oil.—When the oil has been extracted by the press, it contains water and impurities, and it is evident that in order to have an elastic and even mass, it is an advantage to extract these substances. This is done either naturally, allowing the clarification to proceed by simple deposit, or by a direct treatment by means of filtration or a chemical. This last means, which generally consists of treating the oil with sulphuric acid, frees it from substances which do not play any part in its drying qualities, as they do not fix oxygen. As a matter of fact, in a comparative test by exposure to the air of a recently pressed oil and the same oil treated with sulphuric acid, then freed by washing from all trace of the acid, it is seen that in the second case the oil absorbs a greater quantity of oxygen. Moreover, it is evident that the final product will be the whiter, as the oil, to begin with, is less colored, which suggests the necessity of the bleaching operation.

2. Age of the Oil.—Oil preserved from the action of the air absorbs oxygen the better the older it is. It is thought that it is due to the formation of new compounds in the oil. Dr. Fahrion believes that the non-saturated fatty acids enter into combinations among themselves to form new and complex bodies.

3. Method of Preservation of the Oil.—Outside the question of age, if the oil has been kept in such conditions that it has been in contact with the air, it has already absorbed a certain quantity of oxygen. Experience shows that even if to begin with the oil only slowly absorbs oxygen, once this absorption has begun, it proceeds much more rapidly. In any given oil, therefore, the absorption of the oxygen will take place much more rapidly when it has been exposed to the air.

4. Action of Heat.—The temperature at which an oil is exposed to the air has influence upon its drying powers. Chevreul showed that linseed oil dried much more quickly at a temperature of from 25° to 28° C. than at a temperature of from 15° to 18° C. Moreover, if crude linseed oil and the same oil which has first been submitted to the action of the heat are exposed to the air under the same conditions of temperature, a difference in their drying powers will be found. If, for instance, linseed oil is heated for three hours, so that it only disengages a few gaseous bubbles from time to time, the oil becomes much more siccative, as Chevreul has shown. It takes about half as long a time to dry. Dr. Fahrion explains this by saying that, under such conditions, boiling in a deep vessel to which little of the oxygen of the air can gain access, the combination of the non-saturated fatty acids among themselves is accelerated, and complex products are formed capable of absorbing oxygen more rapidly.

Chevreul, in continuing to heat the linseed oil under the same conditions, proved, on the other hand, that the oil heated for five hours is at the end of this time less siccative than the oil heated for three hours only. It is probable that under the influence of this pro-

longed heat a part of the glycerine is destroyed, as a certain acrid smell indicates, and the linoleic acid is set at liberty, and it is known that linoleic acid dries less quickly than linolein. It is probable for the same reason that Mulder has found that linseed oil heated only to from 70° to 100° C. dries less well than crude oil. We can sum up, therefore, as follows: First, that a moderate temperature assists the drying of the crude oil; secondly, that exposed to the same temperature the crude oil dries less quickly than if it had first been submitted to the action of heat, with this reserve, that the action of heat has been such that the oil has not commenced to decompose, with the result that a certain quantity of linoleic acid has been set at liberty.

5. The Addition of Certain Substances.—Long experience has shown that the addition of certain substances, such as white lead, litharge, oxide of manganese, etc., assists the drying of a siccative oil. In certain cases these substances are mixed directly with a cold oil, in other cases heat is used in making the mixture.

Let us first consider the plumbic compounds which have been employed for a long time as driers. The commonest process consists in heating the oil with these plumbic compounds, and the increase of drying power has been attributed sometimes to the formation of linoleate of lead, at the same time that linoleic acid is liberated by the heat, and sometimes to the oxidation produced by the oxygen of the oxide of lead, pointing out as a proof of this that at the end of the operation there is a deposit of a certain quantity of metallic lead.

This double explanation does not seem exact, for the following reasons: In the first place, experience teaches that linoleate of lead gives only factitious drying power, since the product quickly becomes brittle and friable. On the other hand, linoleic acid dries less quickly than linoxine. Nevertheless, it is indisputable that an oil heated with oxide of lead has a drying power greater than a crude oil, or oil cooked without the addition of the oxide. It may be asked, therefore, if it is not owing to the oxygen of the oxide of lead that the drying power is augmented. If it is remembered that a linseed oil of good quality, exposed to the air, absorbs 16 to 18 per cent. of its weight on turning into a solid and perfectly dry substance, and if, on the other hand, we reflect that in practice the quantity of oxide of lead used is not more than 3 to 8 per cent. of the oil, it will be seen that the oxygen that the oxide of lead could furnish is less than 1 per cent. of the weight of the oil, whereas from 16 to 18 per cent. are necessary, and that, therefore, it cannot play anything more than a secondary part from the point of view of direct oxidation, the more so that a part of this oxide of lead does not give up any of its oxygen, since it enters directly into combination to form a plumbic soap. Nevertheless, the presence of a certain quantity of metallic lead at the end of the operation proves that a corresponding quantity of oxygen has been at liberty to commence the oxidation of the oil, and, as we have seen in studying the effect of oxygen on crude oil, the drying proceeds more rapidly after the oxidation of the oil has reached a certain degree. In any case, this reaction seems to be a secondary one, in view of the notable increase of the drying power. The same objections and the same explanation might be made on the subject of the augmentation of the drying power by the use of manganic compounds.

However, a more acceptable explanation may be given, based upon a very important observation made by Chevreul, who showed that if linseed oil were spread on a sheet of lead entirely freed from all trace of oxide, the drying power of the oil notably increased. It is evident in this case that the oil cannot absorb any oxygen, except that which is furnished normally by the air. The augmentation of the drying power is due really to nothing else than the presence of the metal. This experiment may be carried further. If a crude siccative oil is shaken up in a bottle, with very porous lead, obtained by the precipitation of a salt of lead by another metal, it will be seen that without the necessity of any elevation of temperature the siccative oil has a much greater drying power than before this treatment, and in this case it is certain that the oil has not been furnished with any oxygen. The only certain modification is that after the treatment with precipitated lead the oil contains a small quantity of the metal, and we are led to conclude that the augmentation of the drying power is due uniquely to the presence of this small quantity of lead.

The same experiment cannot be made directly with the manganic compounds, but indirectly the oil can be placed in the same conditions with regard to manganese. To do this it is merely necessary to stir up the oil treated with the precipitated lead with a salt of manganese, the sulphate, for instance, which by double decomposition gives a salt of lead insoluble in oil and at the same time manganese as a substitute for the lead. Following out this experiment, it is shown that the oil thus "manganesated" has a very great drying power, superior even to that obtained by heating crude oil with a manganic compound. It is by experimenting upon this manganesated oil thus prepared that it is possible to find an explanation of the augmentation of the drying power. If this oil is spread in a thin coat in contact with the air, it is seen to take a brown tint, due to the oxide of manganese present passing to a superior degree of oxidation, by taking oxygen from the air. But as the oil becomes more viscous the brown tint is seen to disappear; finally this coloration disappears completely, the oxygen of the peroxide of manganese having served to oxidize the siccative oil, and finally a solid mass without color is obtained.

This brown coloration, followed by a complete loss of color, shows that the oxide of manganese has served as an intermediary, itself oxidizing easily by contact with the oxygen of the air, and then giving up this oxygen to the oil.

The action obtained with oxide of lead is very probably similar to this, but with a smaller degree of energy. In an oil to which litharge or manganese has been added, the lead and the manganese play a part of intermediaries, robbing the air of its oxygen to give it up in a continuous manner to the oil, which is thus oxidized more rapidly than it would be without these intermediaries.

It was natural to try if other metals were capable of playing the same part as lead and manganese. The simplest way of experimenting in this direction is to take an oil to which litharge has been added and stir it up with salts of the different metals, to find out which will give with the lead a salt insoluble in the oil. Operating thus, we have proved that if the oil prepared with litharge spread in a thin coat on a plate of glass dries in twenty-four hours, the oil in which the lead is substituted by manganese dries in six hours; by substituting copper, zinc, or cobalt for the lead, the oil takes from thirty to thirty-six hours to dry; and, finally, the oils obtained by substituting nickel, iron, chrome, etc., for the lead are not completely dry until forty-eight hours have elapsed. A very important point to note is that a manganesated oil got by substituting manganese for the lead of an oil prepared with litharge dries much more quickly than an oil manganesated directly.

In practice, in addition to the oxides of lead and of manganese, certain salts of these oxides are used, but their choice seems as if it should be subordinated to their degree of solubility in the oil and the manner in which they behave when heat is employed. In practice, moreover, of all the salts proposed, none other than the acetate of lead and the borate of manganese have been retained, and the explanation of this is easy. It is that these two salts submitted to the heat decompose and give finally either the oxide of lead and very finely divided lead or the oxide of manganese. To take the case of the acetate of lead, it is known that this salt melts in its water of crystallization at about 75° C.; at a temperature higher than 100° C. it loses water and a little acid, giving a sesqui-basic acetate, which is completely decomposed at about 280° C. Carbonic acid and acetone are freed, and as a residue very finely divided lead is obtained, of which we have already seen the important role as a drier.

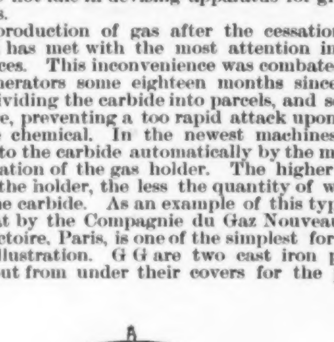
In the case of borate of manganese we have to deal with a very unstable salt, as most of the borates are. The affinity of the boric acid for the oxide of manganese being very weak, under the influence of heat the latter is set at liberty. The use of this salt is, therefore, simply an advantageous way of introducing the oxide of manganese.

As experience has shown that metallic lead in a very porous state augments the drying power of the oil, it was interesting to study the action on the oil of other metals easy to obtain by precipitation. In operating, however, with precipitated copper and tin, it was found that the drying power of the oil did not sensibly increase. This result was to be foreseen, for Chevreul had shown that linseed oil spread on a well cleaned sheet of lead dried much more rapidly than that spread on sheets of copper, brass, zinc or iron. With these metals the drying power was not much more rapid than if the oil had been spread on porcelain, glass, or plaster.—Vernis et Huiles Siccatives; from the Western Painter.

RECENT IMPROVEMENTS IN ACETYLENE GAS GENERATING APPARATUS.

The means for producing acetylene gas are constantly being improved in Paris. Low pressures alone are favorably considered. A very important industrial exhibition just closed in that city showed that inventors are not idle in devising apparatus for giving better results.

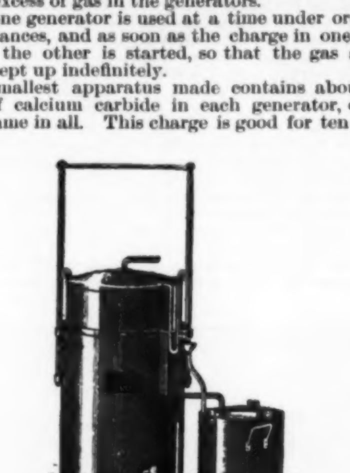
The superproduction of gas after the cessation of consumption has met with the most attention in recent appliances. This inconvenience was combated in Trouvé's generators some eighteen months since by glass rings dividing the carbide into parcels, and so, in some measure, preventing a too rapid attack upon the whole of the chemical. In the newest machines the water is fed to the carbide automatically by the movements of deflation of the gas holder. The higher the elevation of the holder, the less the quantity of water allowed to the carbide. As an example of this type of machine, that by the Compagnie du Gaz Nouveau, 64 Rue de la Victoire, Paris, is one of the simplest for the purpose of illustration. G G are two cast iron pots, readily slid out from under their covers for the pur-



pose of refilling. H H[1] H[2] connect the generators to the gas holder, A, to the top of which is attached a chain, D, acting upon a stop plug, N, within the water reservoir, B, so that the water therein is opened to or cut off from the two supply pipes, F F, feeding the carbide holders. The supply is commenced automatically by means of two spring catches, S S, attached to the sides of the gas holder, pressing back the lever cocks, O O[1]. A little water poured in at one of the funnels starts the holder. K is the gas supply pipe from the gasometer. V is a safety valve, as a precaution against any hitch with the holder; and as the generator pots are closed by the cocks, R R[1], when the apparatus is not in use there would be a chance of these cocks being left shut through a forget when they should be open, so each pot is fitted with a water siphon, the seals of which would naturally be broken by any excess of gas in the generators.

Only one generator is used at a time under ordinary circumstances, and as soon as the charge in one is exhausted the other is started, so that the gas supply can be kept up indefinitely.

The smallest apparatus made contains about one pound of calcium carbide in each generator, or one kilogramme in all. This charge is good for ten hours



with three burners going, each burner using ten liters per hour. The price of the machine complete (and which is well made) is 140 francs. The size of the gas holder is 10¼ by 19½.

Another apparatus, by V. Daix, 72 Rue Louis Blanc, Paris, has the same system for feed water supply, but, instead of using taps in his connecting pipes, this inventor uses water siphons throughout as being less liable to cause errors of working; and, still more important, he divides the carbide into a number of small lots, each of which is preserved from the action of water or vapor until the supply calls for its use. Superproduction of gas is thus reduced to a minimum, as will be readily understood. The inventor estimates that as much as thirty-five per cent. is lost by superproduction in apparatus in which the carbide is not subdivided and preserved from the action of vapor.—Photography.

FOOD TABLETS.

Not long ago an American chemist, evidently a disciple of Prof. Berthelot, of France, stated that the time was near at hand when hot water and food tablets would be the sole accouterments of a kitchen; that the essential food elements of a twelve hundred pound steer can be put into an ordinary pill box, and that a single concentrated soup tablet the size of a pea will make a large bowl of soup of full nourishing strength. A ration case weighing eight ounces was planned. It contained the following supply: Three tablets of concentrated soups, equal to three quarts; four beef tablets, equal to six pounds of the meat; one milk tablet, equal to one pint; two tablets wheaten grits, equal to two pounds; one tablet egg food, equal to twelve eggs.

Viewed from a chemical standpoint, it may seem possible to reduce, by condensation, the bulk of man's food almost indefinitely, and thus furnish in a thoroughly portable and convenient form nutriment for the body which will remain unchanged through long periods of time and in spite of the influence of varying conditions of temperature and climate; but from a physiological point of view may be seen serious obstacles to the successful consummation of such a proposition. That condensed and concentrated foods have a direct sphere of usefulness will not be denied, but that food tablets and similar products are well adapted to constitute the sole food of healthy men for any length of time is an undeniable fallacy. Combined with fresh foods they may yet prove of service; for, like the particles of yeast added to the dough, the necessary principle contained in the ordinary food may leaven the whole lump.

But practical experimental evidence is always most convincing and hence we append the following dispatch which recently appeared in a reliable periodical: "A dispatch from Denver was published stating that the troops at Fort Logan have made the first test of the new emergency ration. One company went out for three days of forced marching in the foothills of Denver, loaded with coffee tablets and compressed soup that was supposed to contain all the advantages of hard tack and coffee. On the night of September 11, the medical officer charged with weighing and watching the men rode into Morrison for assistance. He reported that thirty-six out of the fifty men are down with griping pains resulting from the non-assimilation of the scientific ration. The order could not be revoked, and the men in the field were informed that they would have to remain on the march for two days longer."—Dietetic and Hygienic Gazette.

A TRAVELING NURSERY.

And now comes the traveling nursery to take its place alongside the barber shop, bathroom, etc., on our fast trains, says the Railway Review. The traveling nursery is to take up about the same amount of space as the private stateroom of the ordinary sleeping car. There will be a saving of a space of several feet, however, as the wide seats on the sides of the stateroom below the berths are not needed in the nursery, being replaced by ottomans and tiny easy chairs scattered over the floor. In this way any danger from sudden starts or sharp curves is obviated. As a further protection against injury to the little ones, the walls of the nursery are heavily padded and the floor thickly carpeted, so that bumps and bruises will be altogether avoided. At each end of the compartment, and firmly secured, are two cozy cots in which the smaller children may lie and watch the games of the older ones. Each car containing the nursery attachment will carry a matron or nurse, who will be selected with special re-

ference to her ability to amuse and care for her little charges; and she will have at hand supplies of milk, cookies and other edibles and drinkables dear to the infantile heart. She will also have charge of a medicine chest containing a full assortment of the simpler remedies for childish ailments. A miniature toy shop is another adjunct of the traveling nursery, and it will contain everything from baby rattles to picture books and fairy tales. Nothing, in short, will be missing that would add to the comfort or amusement of the young travelers. It is not intended that every sleeping or parlor car can be provided with the nursery attachment. Large as is the number of children passing, it would be necessary to have but one such car in every through train running between the larger cities. The expense of equipment, matron's wages, etc., would thus be kept down to a reasonable limit. Although child travelers are numerous now, and the sending of them alone from one city to another is increasing each year, railroad officials who have examined plans for the new compartment anticipate an increase in business through their adoption. It will not be long before the railroads will be able to advertise "all the comforts of a home," while en route.

NITROSYLIZED BLAST FURNACE SLAG AS AN ADDITION TO HYDRAULIC CEMENT.

WHEN a cement briquette is kept immersed in water for several months, it loses considerable of its lime, say from 5 to 10 per cent. This portion of the lime is in excess of combination, the cement composition being too basic to yield to it sufficient gelatinous silica to bind it. Hence, nearly all hydraulic cements can be improved by the judicious admixture of silicious substances, that yield an additional supply of gelatinous silica. The volcanic earths, such as trass, santorin and puzzuolane, possess this property to a remarkable degree, but they are not much used for admixture on account of their comparatively high cost. A much cheaper and in some respects excellent substitute is found in blast furnace slag of singulo to sesqui-silicate constitution, high in alumina and lime, and finely pulverized. Dissolving lime reacts only superficially on such admixtures, but it extracts from them a little gelatinous silica, and the resulting compounds—minute particles of hydrosilicate—cement the mass more firmly.

Unfortunately, such slag contains from 1 per cent. to 3 per cent. of calcium sulphide, which is easily decomposed by water containing carbon dioxide. This sulphide obtains in the slag in intermolecular combination, which means that it is rather evenly distributed throughout the whole mass, and that even the smallest slag particles contain some of it. In dissolving—under the conditions in which it obtains in applied cement—it changes readily to calcium-sulphhydrate; the latter, being in aqueous solution, becomes mixed up with the gelatinous silica and with the dissolved lime, and the lime changes it back to sulphide. Thus the forming particles of hydrosilicate, which are to bind the mass more firmly, become tainted with unstable sulphur compounds, hence they are apt to disintegrate and to cause the cemented mass that contains them to weaken long after it has become indurated, sometimes after the lapse of years.

In order to illustrate the slag question more fully, it may be as well to sum up as follows: Crude slag that is sulphurous cements well at first, but is not a reliable constituent, and crude slag that is not sulphurous is usually so acid as to exert scarcely more chemical energy than ordinary sand does. There is, practically, no intermedium, for even the singulo-silicate slag from charcoal blast furnaces contains sufficient of CaS to be, in its crude state, objectionable for the purpose herein considered.

In order to free blast furnace slag from this objectionable feature, several methods have been proposed for desulphurizing such slag in its molten state; but they have not yet been tried, the chief obstacle being that blast furnace managers are very reluctant to try anything that is apt to interfere in the least with other routine work. Moreover, with Rosendale cement selling as low as 70 cents for a barrel of 300 pounds, and with Portland selling as low as $2 for a barrel of 380 pounds net, the cement producers are not over-anxious to adopt any new ingredient unless its use will cheapen the cost of their product considerably; and so the matter rests.

There is, however, a possibility that the recently invented process of nitrosylizing pulverized slag will prove to be of greater commercial interest to both classes of these industries than anything that has thus far been attempted with that much neglected by-product. The main reason for this assumption is, on the one hand, that the condition in which the slag is to be delivered from the dump and paid for can be brought about by the furnace men without causing them any appreciable inconvenience, and on the other, that the slag which is thus delivered can be adapted for cement at a smaller cost than that which would be involved by any other effective treatment that has thus far been proposed. The treatment itself is very simple and offers no new features of general interest; it is fully described in the patent specifications (United States patent, No. 579,820, March 30, 1897), which are rather too long to be reproduced in this paper. Suffice it to state that nitrosylized slag is prepared by moistening finely ground slag of suitable composition with a weak solution of nitric acid, by adding more water after the acid has become neutralized and by drying the leached mass. The complete treatment requires about one-half a pound of 60 per cent. acid (N_2O_5) and about 30 pounds of water for each 100 pounds of pulverized slag, and the product is cheap enough to be even sought after by the manufacturers of Rosendale cement.

The primary object of the treatment is, of course, to eradicate, as it were, the CaS that crops out on the surface of the slag particles. The total quantity that becomes thus eliminated is rather small, and when the acid is used in the above-mentioned proportion it amounts to less than 0·1 per cent. with slag that contains about 2 per cent. This superficial desulphurization is, nevertheless, very effective, for the pores that are produced by the elimination of the sulphide are apt to become closed up by the formation of hydro-silicates in the beginning of the cement reactions, and before any deeper reaction can set in, and thus any future deleterious action of the remaining sulphide is rendered impossible.

The secondary, but not less important, object of the treatment is to utilize the nitrosyl that is set free by the nitric acid while it reacts on the slag particles. In other words, slag of singulo to sesqui-silicate constitution, and high in alumina, contains constitutionally—or aside from purely accidental ferruginous matter—more or less of ferrous silicate, say from 1 to 2 per cent. It is well known that attenuated solutions of ferrous salts absorb nitrosyl with great avidity and under evolution of heat, the thermal effect ranging, according to various authorities, from $+ 9°$ to $+ 11°$ calories. The ferrous silicate of the slag absorbs it likewise; hence it is to be presumed that this absorption must render its silica more disposed to sever its connection with the ferrous oxide, and to become gelatinous, when reacted upon by dissolving lime. The accidental ferruginous matter of the slag also absorbs nitrosyl and is thereby prevented from readily changing on its surface to ferric hydrate. As the formation of ferric hydrate involves an appreciable enlargement of the volume of the particles thus affected, it stands to reason that such a change is not desirable in applied cement; and as one volume of nitrosyl gas requires twenty volumes of water for its solution, it is not likely that nitrosylized slag is apt to "rust" very quickly.

Coming now to the question of the actual efficiency of nitrosylized slag, the writer has arrived at the following conclusions:

1. High-class Portland cements, those that have been ground from carefully prepared stock that has been burned very hard, can only be improved by the admixture of small quantities, probably not exceeding 10 per cent. in the average.

2. Inferior Portland cements may be mixed with about their own weight of nitrosylized slag, and still give as good results as the neat. The following tests, recently made in the usual way, with briquettes of standard size, may serve as an illustration:

A.—TEST OF HIGH-CLASS PORTLAND CEMENT.

No.	Composition of Mixture.	Water added. Per cent.	Age. Days.	Tensile strength per square inch. Pounds.
1	Neat cement	25	18	563
2	" "	25	17	526
3	Cement: 80%; slag: 20%	25	16	426
4	" 60%; " 40%	22½	18	305

B.—TESTS OF AN INFERIOR PORTLAND CEMENT.

No.	Composition of Mixture.	Water. Per cent.	Age. Days.	Tensile strength Pounds.
1	Neat cement	23	19	310
2	Cement: 60%; slag: 40%	17	19	335
3	" 40%; " 60%	16	19	310

Briquettes made up of cement, nitrosylized slag and sand are apt to give rather poor comparative results as regards their test for tensile strength unless the sand is added after the cement and the slag have been thoroughly wet-mixed, for it is scarcely possible to dry-mix three different substances as well as two. A much fairer test would be to slurry the mixtures, just as is done in working cement for the "second set," and to fill the slurry into the moulds without beating it. The limit of tensile strength would then be barely as high as in testing by the usual method, but it would certainly be more in accord with the amount of resistance which the respective mixtures actually acquire in being applied to masonry.

A briquette, made by casting the mixture into the mould, and composed of:

Cement "A" 90 per cent. and nitrosylized slag 10 per cent., the water added being 30 per cent., broke when 17 days old at 350 pounds tensile strain per square inch. This is a pretty fair result, considering that this mode of testing is apt to lower the limit of tensile strength of even the best cements 40 per cent. or thereabout.

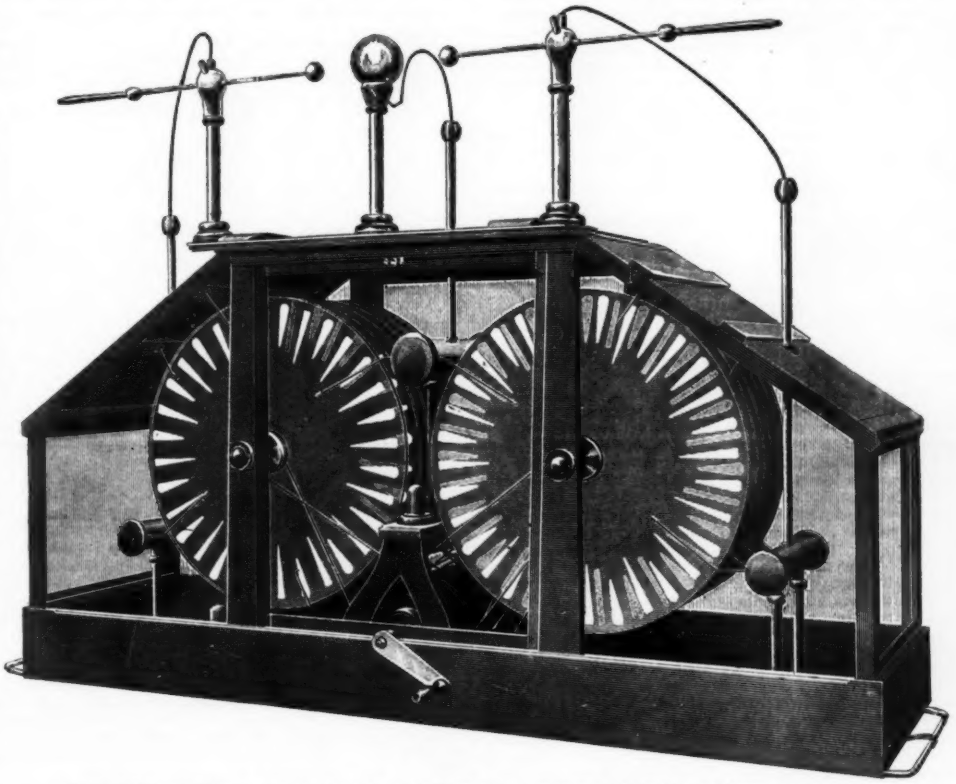
The above notes were published by Mr. A. D. Elbers in the Engineering and Mining Journal.

SOIREE OF THE ROYAL SOCIETY.

THE last Royal Society soiree took place at Burlington House in May. The place of honor in the council room was given to Mr. A. A. C. Swinton, whose researches into the nature and behavior of X rays are so well known.

Mr. Swinton's experiments dealt both with cathode rays and X rays. In relation to the former he showed that by replacing the usual screen of fluorescent material by one of ordinary electric light carbon, much appears which was previously invisible. When a concentrated stream of powerful cathode rays is focused on a surface of carbon, a brilliant luminescent spot appears on the carbon at the point of impact of the rays. The effect is entirely on the surface, and when the cathode stream is rapidly deflected by a magnet the luminescent spot moves with no perceptible lag. The tube in which these phenomena were shown was kept connected to the pump, because the vacuum is rapidly reduced by the hydrocarbons thrown off by the carbon.

In tubes of the ordinary focus type with a single spherical concave cathode the rays appear to converge in a cone to a focus, and if the vacuum be not too high, to diverge again in another cone upon the other side of the focus. At higher vacua the rays do not appear to diverge again at once, but seem to form themselves into a thread which connects the convergent and divergent cones. Mr. Swinton showed that, if the divergent cone is thrown on to a thin platinum disk, it quickly attains a red heat. The disk usually becomes uniformly heated, but if an electric light carbon disk be employed, there is, in some cases, seen an apparently white hot ring with a well defined dark and seemingly cold interior. As the dimension of the cone of rays is varied by altering the vacuum, the ring alters correspondingly in diameter. Mr. Swinton has, also, been able to show that the converging cone of rays also acts under certain circumstances as if it were hollow. In order to investigate the cathode rays in a focus tube still further, and more especially in order to discover whether the various rays cross one another at the focus, or again diverge without crossing, Mr. Swinton showed a tube with a carbon anti-cathode which was also the anode, fixed at the opposite side of the focus from the cathode, with the focus about equally distant between it and the cathode. A section of the aluminum cathode, equal to about one-eighth of its total area, was removed. When the luminescent ring was produced, it was shown that instead of one-eighth of the circumference being wanting, actually seven-eighths were missing. The portion of ring that did appear was of a length corresponding exactly to the arc of the removed section of the cathode. Hence it appears that there is no rotation of the cathode beam as a whole, and that the rays do not cross at the focus; and further, that when the hollow convergent cone is, as it were, split in this manner, some unexplained action, similar in effect to a circular surface tension, causes the gap to widen out and the remaining portion of the ring-shaped section to contract correspondingly, without, however, altering its diameter. Another tube designed to investigate the same matter was shown. In this the cathode was of the usual form, but a small aluminum spike could be moved up and down the tube between the cathode and the anti-cathode. This piece of aluminum projected from the wall of the tube nearly to the center, and filled up very nearly one-quarter of the circular sectional area. On putting this obstacle slightly in the divergent cone, exactly one-quarter of the ring



THE WIMSHURST INFLUENCE MACHINE AT THE ROYAL SOCIETY SOIREE.

on the anti-cathode failed to appear, and this result was maintained when the obstacle was moved further into the cone. There was no displacement of the gap, and no rotation of the divergent cone. The point was then moved into the convergent cone of cathode rays, when a small portion of the ring on the carbon was cut out, but on the opposite side, showing that the rays cross one another's paths at the focus without rotation.

Mr. Swinton's experiments with X rays were directed to showing how the penetrative power could be varied to suit different conditions. It is known that as the vacuum is improved the rays become more penetrative, until a point is reached when the bones of the hand become almost as transparent as the flesh. Similarly at any degree of vacuum, the penetrative value is increased by increasing the power of the Ruhmkorff coil. Similar results can be obtained by varying the resistance of the tube by means of a magnetic field. The simplest method, however, is, as Mr. Swinton showed, by altering the distance between the cathode and anti-cathode. He had a tube in which the anti-cathode of aluminum, faced with platinum, was connected to the anode by a sliding steel rod, so that it could be moved along the axis of the tube, and the distance between the cathode and the center of the anti-cathode varied from 1 in. to 3 in., the anti-cathode being always outside the focus of the cathode. As the anti-cathode was moved toward the cathode, the penetrative value of the rays, as seen on a screen, was visibly increased, and when the motion was in the opposite direction, there was a corresponding decrease. Another tube had two cathodes, both focusing on opposite sides of the same platinum anti-cathode. The two cathodes were of different diameters, one being 0·375 in. and the other 1·125 in. With a degree of exhaustion that gave plentiful X rays with the small cathode in action, no X rays could be obtained by aid of the larger cathode. When the exhaustion was carried further, X rays of low penetrative power were produced from the large cathode, and rays of greatly increased penetrative power were obtained from the small cathode. In another lamp there were four anti-cathodes of different sizes, any one of which could be turned to face the cathode, and it was shown that the smaller the anti-cathode, the greater was the penetrative value of the rays. The penetrative value of the X rays produced by any given tube appears, therefore, to be dependent upon several conditions:

1. The penetrative value is higher for a high vacuum than for a low vacuum.

2. It is higher when the electrical power applied is great than when it is small.

3. It is higher when the resistance of the tube is great than when this resistance is reduced by magnetic means.

4. It is higher when the distance between the cathode and anti-cathode is small than when the distance is great.

5. It is higher when the cathode itself is small than when it is large.

6. It is higher when, as a consequence of one or more of the above, the potential difference between the cathode and the anode portion of the tube, and consequently the electrical excitation of the cathode, is great than when it is small.

Mr. Swinton's experiments attracted a large gathering all the evening, and excited the liveliest interest.

Another electrical exhibit of a curious and interesting nature was that of Mr. J. W. Swan. He showed a number of glass dishes containing resin covered with patterns of great complexity and much beauty. These were produced by placing the resin between two poles of an induction coil in action. No spark passes to the resin, which is merely subjected to strain, the spark being taken between an auxiliary pair of terminals. When the resin is removed it shows no trace of any effect. If, however, it be warmed through, the surface puckers up into patterns as the mass softens, owing to internal strains set up by the electric stress, which do not seem able to relieve themselves while the resin remains hard. These strains persist for a long time—for weeks, if not months.

Some of the samples shown had been developed three months after the resin was electrified. The patterns produced at the negative pole were quite different from those at the positive pole. Before the heating the plates were exposed to dust. In one dish there was a viscous mixture of resin and oil which flowed under electrification, and heaped itself up in various patterns.

Mr. James Wimshurst has lately constructed the machine which we illustrate. This, as will be seen, is of immense size—much larger than has ever been seen in London before—and gives torrents of electricity. Like everything shown by Mr. Wimshurst, it has been entirely designed by himself, and made in his own workshop, largely by his own hands. It is duplex in form, and on each side contains 12 plates, 36 in. in diameter; on each plate there are 32 sectors, the arrangement being such that the machine excites itself with absolute certainty before the handle has made a complete revolution. The length of spark is 32 in. between the two outer terminals, the large ball in the center forming a sort of half-way house between the two outer ones. The outside dimensions of the machine are 9 ft. in length by 2 ft. 9 in. in width.—Engineering.

EXPORTS TO LATIN AMERICA.

THE good ship Mexican Prince, which sailed from New York recently, had on board a somewhat diversified cargo, the details of which may do as a very fair illustration, says the New York Sun, of the variety of the cargoes sent from this city to South American ports. The notion is general that New York's chief exports to Europe are cereals, provisions, petroleum, and tobacco, and to South American ports machinery. But a mixed cargo to South American ports is a mixed cargo, indeed, if the case of the Mexican Prince may be taken as a sample.

There were 3 cases of refrigerators, 20 of bicycles, 11 cases of typewriters' supplies, 21 packages of empty bottles, 13 cases of baking powder, 20 cases of scales, 75 consignments of plows, 5 cases of tooth powder, 26 consignments of oars, 1 case of bird cages, 1 of slot machines, 84 consignments of pumps, 1 case of photographs, 27 consignments of hay presses, 12,000 boxes of matches, 2 bales of seed, 2 consignments of rakes, 4 consignments of emery wheels, 2 cases of cigarettes, 6 consignments of desks, 4 consignments of bedsteads, 4 consignments of cartridges, 60 boxes of clocks, 2 cases of towel racks, 31 harvesters, 1 case of phonographs, 24 boxes of soap, 40 stationary engines, 152 sewing machines, 100 cases of shoe blacking, 108 consignments of chairs, 11 cases of typewriters, 400 paper boxes, 3 consignments of firearms, 6 consignments of toys, 165 boxes of carpet tacks, 800 sets of harness, a bale of sponges, 59 cases of sandpaper, 377 packages of illuminating lamps, 5,000 pounds of candy, 15 machines for rice manufacture, 26 bales of wicks, 700 gallons of benzine, 100 pounds of confectionery, 1,000 gallons of naphtha, 1,000 yards of oilcloth, 377 consignments of cutlery and 200 bottles of American medical bitters.

On the same day the good ship Finance cleared for Central America with a mixed cargo of candles, hardware, photograph apparatus, stationery, paper, and drugs. Other items of American exports to South and Central America were cotton duck, sausages, pumps, codfish, hats, hams, telephone receivers, perfumery, carts, bottled beer, clothes wringers, paints, staves, stove polish, bellows, whips, oleomargarine, cartridges, peanuts, tape, cider in barrels, coffee roasters, ice cream freezers, crucibles, twine, hoes, forks, cots, needles, wheaten grits, and netting. American exports to South and Central American cities are much more varied in kind than is usually believed to be the case. The exportation of agricultural implements is large to only one country of South or Central America—the Argentine Republic. American books are extensively exported to Brazil, coal to Cuba, machinery to Brazil, lard to nearly all South American ports, dairy products to the West Indies, wood to Honduras, woolen manufactures to Mexico, fish to the West Indies, cotton goods and wearing apparel of cheaper variety to the Central American states.

SOME SHIPS OF THE ANCIENTS.*

NOAH'S ARK.—The first vessel ever known to have floated on the face of the deep, as well as the largest, may well claim to have a first place among the most remarkable ships. Burchett, in his "Naval History," alluding to the ark, says, "To the immediate providence of God are we to attribute the invention of shipping." Beyond its dimensions and the object of its construction, we have but little record of this primitive vessel. The following is the description of the ark as given in the sixth chapter of Genesis: "And God said unto Noah, make thee an ark of gopher wood; rooms shalt thou make in the ark, and shalt pitch it within and without with pitch. And this is the fashion which thou shalt make it of: The length of the ark shall be three hundred cubits, the breadth of it fifty cubits, and the height of it thirty cubits. A window shalt thou make to the ark, and in a cubit shalt thou finish it above; and the door of the ark shalt thou set in the side thereof; with lower, second and third stories shalt thou make it." As Noah and his sons went into the ark in the "600th year of his life, in the 2d month, on the 17th day of the month," and left it in the "601st year, 2d month, 27th day of the month of his life," he must have inhabited the ark for a year and ten days. Allowing the usual measure of the cubit, which was one foot nine inches and eight hundred and eighty-eight thousandths, we find the ark was five hundred and forty-seven feet and a fraction in length, about ninety-one and a half feet beam, and was nearly fifty-five feet in height. Its tonnage has been variously estimated from twelve thousand tons to as high as forty-two thousand four hundred and thirteen tons. Dr. Hales, a writer in the Nautical Magazine, January, 1854, calculates its tonnage as eleven thousand nine hundred and five tons, and its external bulk one million five hundred and eighty thousand feet, which is nearly six thousand tons less than the capacity of that modern ark, the Great Eastern. The name would imply that it was coffer-shaped, or simply a square box, hence the calculation of its greatest tonnage, which would give it the capacity of eighteen line-of-battle ships, or about fourteen times the tonnage of one of the Collins steamships.

The ark was as long as St. Paul's Cathedral, London, nearly as broad and half as high. According to the biblical account, it was pitched within and without.

In length the ark was not remarkable, for it is exceeded by that of the Great Eastern and City of Rome, and several of our modern steamships are nearly five hundred feet long.

It would appear from the account in Genesis that it was one hundred and twenty years in building.† The wood of which the ark was constructed was "gopher wood," which has been translated cedar, pine, box, etc., but is generally supposed to have been cypress, that wood being least subject to decay, the sap of it being so offensive that no worm or other corroding animal will touch it.

The structure of the ark was adapted to the burden it was to carry and the weather it was to endure. We read that it had one door in the side, and that it had one window twenty-two inches square, which was rather a small allowance for light and ventilation, and that it had three stories, or, in other words, was a three-decker. Such is our limited knowledge of the first, and until our own times the greatest, ship the world has ever known.

Early in the seventeenth century Peter Jansen, a Dutch merchant, caused a ship to be built answering in its respective proportions to those of the ark. At first Jansen's ark was looked upon as a fanatical vision of his, and while it was building he and his ship were the sport of seamen; but afterward, says an old writer, "it was discovered that ships built in this manner were, in time of peace, beyond others, most commodious for commerce, because they would hold a third part more without requiring any addition of hands."

In length the ark was six times its breadth, which is about the proportion of the length and breadth of the large sea and war steamers of twenty years ago and of our modern clipper ships.

Whether the ark was of sufficient capacity to accommodate all the men and living things ordered into it, with the requisite provisions for twelve months, I shall not undertake to decide. It has been calculated that eight persons and two hundred and eighty pairs of quadrupeds (which, according to Buffon, is the utmost number of distinct species), with fowls, reptiles and insects that could not live under water, and all the necessary food for a year, could be easily admitted. Noah was instructed to make rooms, but, says the writer just quoted, "God's power was present, so that the harmony of the animals can be easily accounted for."

Not many years after the flood it became necessary for the descendants of Noah to construct vessels to convey themselves and their families to the territories allotted them.

The isles of the Gentiles (Genesis x, 2–5) were assigned to the sons of Japheth, and Kittim, his grandson, according to Josephus, settled in the island of Cyprus, and from his name not only islands in general, but most maritime places, were in the Hebrew language termed "Kittim." The isles of the Gentiles are supposed to have been the islands of the Mediterranean and Ægean Seas.

For the purpose of comparison we will state that the British steamship Inca was just half the length of the ark, and her other proportions the same, that is, her breadth was one-sixth the length and her depth one-tenth the length.

The largest vessel of war in the world in 1883 was the Italian ironclad Italia, which was four hundred feet long, had seventy-three feet beam and measured thirteen thousand eight hundred and ninety-eight tons. Her sister ship, the Lepanto, had the same length, three inches more beam, and measured thirteen thousand five hundred and fifty tons.

The largest merchant steamer and vessel in the world, in 1883, was the Great Eastern, which measured eighteen thousand nine hundred and fifteen tons, and was six hundred and ninety-nine feet six inches long and eighty-two feet six inches broad.

The longest vessel in the world, in 1883, and the largest merchant steamer, save the Great Eastern, was the steamship City of Rome, whose dimensions were: Length, five hundred and eighty-six feet; breadth, fifty-two feet three inches; depth of hold, thirty-seven feet; tonnage, eight thousand eight hundred and twenty-six tons. Her weight was eight thousand tons, and her displacement at twenty-six feet mean draught was thirteen thousand five hundred tons.

Mr. James Napier devotes one section of his "Manufacturing Arts in Ancient Times" to a consideration of the particulars given in connection with the ark of Noah. According to the length of the "cubit" (either 18, 21 or 25·025 inches), the length of the vessel was from four hundred and fifty to six hundred and twenty-five feet, the breadth from seventy-five to one hundred and four, the depth from forty-five to sixty-two. The result given by calculations founded on the longest unit indicates a vessel fifty-five feet shorter than the Great Eastern, her length being six hundred and eighty feet; the lowest dimensions equal those of any vessel which we build at present for long sea voyages. He holds the opinion that the directions given in the sacred record were given in an age in which the art of shipbuilding had received considerable development. The proportion indicated—length six times the breadth—is that at present in favor in the construction of vessels designed to carry large cargoes with the greatest speed and to be capable of encountering heavy seas. "Looking at the whole structure from a workman's point of view," Mr. Napier remarks, "there would be required not less than twenty-five thousand loads of timber for its construction. The cutting down of such a number of trees as would be required, their conveyance to the building yard, the preparation of the wood for the timbers, of whatever shape they were, and the fitting of the different parts, indicate a great amount of skill on the part of the workmen. Whether the fastenings were of wood or metal we, of course, cannot decide; but, considering what we have seen of the knowledge of metals in ancient times, it is more than likely both were used." He concludes that the vessel was built upon some inland plane, contiguous to a plentiful supply of wood, an arrangement which would facilitate the collection of the cargo to be saved in the ark and account for the door in the side, as also for much of the derision of those who heeded not the preacher's warning. Mr. Napier challenges the popular notion that the waters rose gradually and steadily, the words translated "the waters prevailed" indicating that they bore down everything before them. Mr. Steinmetz, in his book on "Meteorology," concludes—from the statement that the water rose, in forty days and nights, to the height of fifteen cubits above the highest mountains—that the rate of rising was five inches per minute, or twenty-five feet per hour—sufficient to destroy every living thing in the space of half an hour. But, supposing the rate reduced to less than half, two inches per minute, no opportunity would even then have been afforded for hill climbing, as such a shower would have swept down everything movable before it. Ordinary seagoing vessels would not have furnished means of escape. "Even within our own day, in South America, earthquakes near the sea have been destructive to everything near them, and all vessels within the influence of the great wave have been destroyed, and these were but slight compared with the flood." The fact must also be considered that those who escaped would not have been likely, except in expectation of such a catastrophe, to have been provisioned for twelve months. The ark had probably then to encounter wind, waves and currents, and as a vessel without rudder in currents and wind always drifts side on, to the serious discomfort and jeopardy of every living creature on board, Mr. Napier infers that the vessel was provided with steering gear and means of propulsion. The phrase "God shut him in" does not preclude the idea that "Noah might have wrought his vessel as any captain would his ship," and "there being no apparent destination, the guidance would only be to keep it in the most favorable position for the comfort of the inmates." To the objection, "How could Noah and his three sons and their wives—eight persons in all—manage such a vessel by the ordinary means?" Mr. Napier replies, "The simplest explanation of the difficulty is that Noah and his sons,

* By George Henry Preble, Rear Admiral U. S. N., in the United Service.

† From this and that the age of Noah is given as six hundred years, it would seem that the word that has been translated as year must mean some other measure of time than the modern year. Perhaps a lunar month was meant, which would make the ark ten years under construction, and Noah's age about fifty when he entered the ark. A wooden vessel one hundred and twenty years in building would be rather rotten when floated.

like Abraham and the other patriarchs, are named as representing their households, and these included a great many servants, both male and female. Indeed, the invitation into the ark ['Thou and all thy house'] suggests this. There are many instances of this use of language in the Old Testament history where only the head of the house is named singly but historically he represents his whole family and adherents. The Chaldean tablet states that there were many people along with the person named—the Noah of the Bible; and as we have shown that this is not only not contrary to the Scripture account, but essential to it, we accept it as strong evidence of the correctness of our opinion." To the objection that might be urged that this explanation minimizes the amount of miraculous intervention ordinarily associated with the preservation of the ark and its inmates, Mr. Napier replies that "a continued miracle is contrary to God's way of dealing when the effect can be obtained under the ordinary laws."

The Leontophorus, mentioned in Memnon, and related as translated by Palmerius, was a ship admirable as well for its beauty as its bulk; it had eight tiers of oars, one hundred in each tier—eight hundred on each side, and in all sixteen hundred! This passage and some others have occasioned a great controversy among antiquarians, whether there were more than one man at the long oars of ancient ships, it seeming a thing impossible for such long oars to be managed by one man.

Demetrius Polioreetes seems to have been the best shipbuilder among the ancients. Plutarch reports that the bulk of his ships surprised his friends, and their beauty created some delight in his enemies. He built two ships of sixteen and another of fifteen ranks (banks ?) of oars, which moved as easily as those of lesser size; and warlike machines for sieges so well contrived that they astonished his enemies; so that Lysimachus, his mortal foe, having obtained the power of seeing his ships and machines, surprised at the contrivance, cried out that they were built with more than human art.

A very extraordinary ship was built by Caligula, adorned with jewels in the poop, sails of many colors, large porticos, bagnios or baths; rooms for entertainments richly furnished, also decorated with vines and fruit trees in nice order. This ship foundered in the sight of Claudius, and was irrecoverably lost in the port of Ostia.

Athenæus* gives a list of the fleet of Ptolemy Philadelphus, viz.: Two of thirty tiers of oars, one of twenty, four of thirteen, two of twelve, fourteen of eleven, thirty of nine, thirty-seven of seven, five of six, seventeen of five, four of three and a half tiers, which were called trieremiobia. The rest of the ships which were distributed about the whole empire were above four thousand.

THE ALEXANDRIA OR ALEXANDRIAN.—This celebrated vessel, built for Hiero, King of Syracuse, under the direction of Archimedes, intended for a corn trader, was at first called the Syracuse; but when Hiero presented her to Ptolemy he named her the Alexandria. She was built during or preceding the siege of Syracuse, which terminated 213 B. C., and though armed for war, had all the sumptuous fittings of a pleasure yacht, and yet was ultimately used to carry corn. Her dimensions are not given.

This ship, famous in ancient times, and a wonder even now, was the subject of a particular treatise by Moschius, the substance of which has been fortunately preserved by Athenæus, and is here presented: For the making of this ship (he tells us) there was cut down on Ætna so much timber as would have made sixty ordinary galleys; besides which the wood for treenails, ribs, and knees was procured from other parts of Sicily and from Italy, and materials for cordage were fetched from Spain and the river Rhoderus, as were other necessaries from other places. King Hiero, having hired shipwrights and other workmen for their services, placed Archias, a Corinthian architect, over them, but all under the supreme direction of Archimedes; and exhorting them to carry on the work diligently, and, to encourage them in it, he would be whole days present at their labor. The number of men employed was three hundred master workmen, besides their servants, who in six months built the ship up to the half of its designed height; and as the several parts were finished they covered them with sheet lead to preserve them from the injuries of the weather. When thus far advanced Hiero ordered her launched, that the rest of the work should be perfected afloat; but how to get this vast pile into the water they knew not, until Archimedes invented the engine called the helix, by which with a very few hands he drew the ship into the sea; when in six months more she was entirely completed and driven full of large nails of brass, many ten pounds weight and others of fifteen, which were let into the timbers by large auger holes, to rivet them well together, and covered on the outside with pitched cloths, over which were nailed plates of lead.

The ship had twenty-five banks of oars and three decks, to the lowest whereof next the hold there was a descent by several pairs of stairs. The middle deck had on each side of it fifteen apartments for dining, each furnished with four couches such as are used to recline on at their meals. On the same deck was accommodation for the mariners, having fifteen couches and three large chambers for men and their wives, each having three beds; next which was the kitchen on the poop, the floors of all which were paved with mosaic, representing the whole story of the Iliad. Suitable to so rich a floor was the workmanship of the ceilings and door to each apartment. On the upper deck was a place for exercises and a fine walk, wherein were several garden plots furnished with plants of all kinds, which were watered by leaden pipes laid to them from a great tank or reservoir of fresh water, where were also arbors of ivy and vines set in hogsheads of earth, whose roots were in the same way watered. Next to these was a department devoted to the pleasures of love, the pavement of which was of agate and other of the richest stones that were found in Sicily. The roof was of cypress wood, and the doors of ivory and the wood of the almung tree. It had three beds in it, and was richly adorned with pictures, statues, and drinking vessels of exquisite workmanship. Adjoining this was a room for retirement and conversation, which was furnished with five couches and wainscoted with box, having doors of the same wood. Within this there was a library, and in the ceiling thereof a fine clock made in imitation of the great dial of Syracuse, as also a bagnio or bath with three brass cisterns, and a bath which held forty gallons, adorned with gems called tauromenites. There were also a great number of cabins for the marine soldiers, together with twenty stables for horses, ten on each side of the deck, and good accommodations for the horsemen and grooms. In the forecastle was the tank for fresh water, made of planks well lined with cloth and pitch, which held two hundred and fifty-three hogsheads, and near it was a well lined with sheet lead, which, being kept full of sea water, nourished great numbers of fish. From the ship's sides there jutted out several beams, whereon were made places for keeping wood, as also ovens, kitchens, mills, and other necessary offices, each of which beams was supported on the outside by a carved image nine feet high.

The whole ship was handsomely painted. She had eight wooden towers, two on the forecastle, two on the poop, and the remaining four amidships; from each of these there jutted out two beams, whereon was raised a breastwork full of loopholes, from whence an enemy might be annoyed with stones. Each tower was full of those and other missive weapons, and was constantly guarded by four soldiers completely armed, with two archers. On this upper deck there was also raised a stage with a breastwork around it, whereon was placed a machine invented by Archimedes which would fling stones of three hundred pounds weight and darts eighteen feet long a distance of a hundred and twenty paces. Around this machine were hung by chains of brass curtains composed of large cables for its security. The ship was furnished with three masts, and each of them with two engines for throwing stones, from whence also large iron hooks and dolphins of lead were to be flung into an enemy's ship. It was also fortified with an iron palisade all around to prevent an enemy's boarding, and had grappling irons in readiness in all quarters wherewith to seize and bring to such hostile vessels as it might be engaged with. Sixty soldiers completely armed kept constant guard on each side of the ship, and as many at each of the masts and their respective engines. The "round tops" were of brass, and constantly guarded by three men in the main and two in each of the others, to whom, in case of action, stones were to be conveyed in baskets by the help of certain tackle for that purpose, and they were to be supplied with darts and arrows by boys appointed to that service. The fore and mizzen masts for this marine monster were without difficulty procured in Sicily, but a main mast of proper dimensions was hard to be got, until one was at length found in the mountains of Britain by a swineherd, which was brought down to the sea by Phileas, an engineer of Tauromenium. The ship was furnished with four anchors of wood and eight of iron, and though her sentena or sink was of so great size and depth, its one pump, by a device of Archimedes, was able to empty it managed by only one man. She had several tenders to accompany her, one whereof was a galley called the Cercurus, and the rest fishing boats and other small vessels. Her whole company was a great multitude, there being on the forecastle alone six hundred seamen always in readiness to execute such orders as should be given. The power of punishing all faults and misdemeanors done on board was committed to the captain, master, and master's mate, who gave sentence according to the laws of Syracuse. There were put on board of her sixty thousand bushels of corn, ten thousand barrels of salt fish, twenty thousand barrels of flesh, and as many bales of goods and necessaries, besides all the provisions for her company. Hiero, or Hieron, finding all his harbors either very dangerous for a ship of so vast a burden or else not capable at all to receive her, came to the resolution of presenting her to Ptolemy, King of Egypt, to whom she was accordingly sent and towed in safety to Alexandria.

This Ptolemy, who was surnamed Philopater, was already possessed of two ships of extraordinary dimensions, of his own building, which will be described hereafter. After the arrival of the Syracuse at Alexandria, she was hauled on shore, and nothing further is recorded of her. We may add that Archimelus, a Greek epigrammatist, wrote a little poem on the large vessel, which was rewarded by Hiero with a present to its talented author of one thousand measures of corn—a premium proportioned, if not to the poem, at least to the magnitude of the theme celebrated.

THE ISIS.—Still earlier than this hulk of Ptolemy's was the Isis, built by the Egyptians. She was one hundred and eighty feet in length, forty-five feet in breadth, and forty-three in perpendicular height from the bottom of the pump well. This vessel did not differ materially in form or dimensions from an English first-rate built at the close of the last century, except that she was rather larger in proportion to her breadth of beam. Her tonnage has been calculated at one thousand nine hundred tons.

PTOLOMAUS PHILOPATER'S TWIN WAR SHIP.—The description of a grand and magnificent war ship built by Ptolomaus Philopater, king of the Grecian-Egyptian empire from 221 to 204 B. C., its construction, equipments, and process of launching it, etc., is furnished by Athenæus in his fifth book.* Her tonnage, builders' measurements, has been estimated at six thousand four hundred and forty-five tons, and her external bulk eight hundred and thirty thousand seven hundred cubic feet.

"Philopater built a ship with forty ranks of rowers, being two hundred and eighty cubits (five hundred and sixty English feet) in length and thirty-eight cubits (seventy-six feet) from one side to the other; and in height up to the gunwales it was forty-eight cubits (ninety-six feet), and from the highest part of the stern to the water line fifty-three cubits (one hundred and six feet); and it had four rudders, each thirty cubits (sixty feet) long; and oars for the thranitæ, the largest thirty-eight cubits (seventy-six feet) in length, which from having a lead in their handles, and because they were heavy in the part inside the ship, being accurately balanced, were, in spite of their bulk, very handy to use; and the ship had two heads and two sterns, and seven rostra or beaks, one of which was larger than all the rest, and the others were of smaller size, and some of them were fixed to the ears of the ship; and it had twelve undergirths to support the keel, each six hundred cubits in length. And it was well proportioned to a most extraordinary degree; and all the appointments of the vessel were admirable, for it had figures of animals in it not less than twelve cubits in size, both at the head and at the stern, and every part of it was inlaid and ornamented with figures in war; and the space between the oars down to the very keel had a running pattern of ivy leaves and thyrsi; and there was a great store of every kind of equipment to supply all parts of the ship that might require any. And when it put to sea it held more than four thousand rowers and four hundred supernumeraries; and on the deck were three thousand marines, or at least two thousand eight hundred and fifty. And besides all these, there was a large body of men under the decks, and a vast quantity of provisions and supplies. The vessel was launched originally from a sort of framework, which was created and made out of the wood of fifty ships of five ranks of oars; and it was launched by the multitude with great acclamations and blowing of trumpets. But after that the Phenician devised a new method of launching it, having dug a trench under it equal to the ship itself in length, which he dug close to the harbor. In the trench he built props of solid stone five cubits deep, and across them he laid beams, running the whole width of the trench, at four cubits distance from each other; and then making a channel from the sea, he filled all the space which he had excavated with water, out of which he easily brought the ship by the aid of whatever men happened to be at hand; then closing the entrance which had been originally made, he drained the water off again by means of engines, and when this had been done the vessel rested securely on the aforementioned cross beams."

The Thalamegus, a river vessel, also built by Philopater, is described by Athenæus:

"Philopater also built a vessel for the river, which he called Thalamegus, or the carrier of his bed chamber, in length half a stadium (or three hundred feet English), and in width at the broadest part thirty cubits (sixty feet), and the height, together with the frame for the awning, was little short of forty cubits (eighty feet); and its appearance was not exactly like ships of war nor merchant vessels either, but it was something different from both on account of the necessity imposed by the depth of the river, for below it was flat and broad, but in its main hall it was high, and the parts at the extremity, and especially at the head, extended a sufficient length, so as to exhibit a very pretty and elegant sweep. This ship also had two heads and two sterns, and it rose to a considerable height above the water, as was necessary, because the waves in the river often rose very high. In the middle of its hull were constructed banqueting rooms and sleeping rooms, and everything else which may be convenient for living in, and around the ship were double corridors running about three sides, each of which was not less than five plethra in circumference. The arrangement of the lower one was like a peristyle, and that in the upper part was covered in and surrounded with walls and windows on all sides. When you first came into the vessel by the stern your eye was met by a colonnade open in front and surrounded by pillars, and opposite to it in the bow of the vessel there was a sort of proscenium covered in overhead. Again, in the same way, in the middle of the vessel, was another colonnade open behind, and an entrance of four folding doors led to it. Both on the right hand and on the left there were windows admitting a pleasant breeze. To these was joined a room of very large size, and that was adorned with pillars all around, and it was capable of containing twenty couches. The greater part of it was made of split cedar and of Milesian cypress, and the doors which were around it, being twenty in number, were put together with beams of citronwood having ivory ornaments. All the nails and fastenings which were visible were made of red brass, which had taken a polish like that of gold from the fire. The whole of the capitals of the pillars were of gold, and there was a sort of girdle on them having figures of animals beautifully carved in ivory more than a cubit (two feet) high, of which the workmanship was not so conspicuous as the exquisite beauty of the materials. There was a beautiful roof to the banqueting room, square, and made of cypress wood; its ornaments were all carved, having a golden face. Next to this banqueting chamber was a sleeping chamber holding seven couches, and to that there was joined a narrow passage, which separated the women's chamber from this one by the width of the hold. By the passage was a banqueting room holding nine couches, very like the large one in the sumptuousness of its furniture, and a bed chamber holding five couches. As to the rooms then on the first deck, this was the general appearance presented. But when you had ascended by the stairs, which were close to the before mentioned sleeping chamber, there was another chamber capable of containing five couches, having a vaulted oblong roof. Near it was a temple of Venus, in form like a rotunda, in which was a marble statue of the goddess. Opposite to this chamber was another banqueting room, very sumptuous, adorned all round with columns, for the columns were all made of Indian stone. Near to this banqueting room were sleeping chambers, with furniture and appointments corresponding to what has been already mentioned. As you went on toward the head of the vessel was another apartment dedicated to Bacchus, capable of holding thirteen couches, surrounded by pillars, having its cornices all gilt as far down as the epistyle, which ran round the room, but the roof corresponded to the character of the god. In it there was at the right hand a large cave constructed, the color of which was stone—for, in fact, it was made of real stone and gold—and in it were images placed of all the relations of the king made of the stone called lychnites. There was another banqueting room, very pleasant, above the roof of the greatest apartment, having an arrangement like that of a tent, so that some of it had no actual roof; but there were arched and vaulted beams running along the top at intervals, along which purple curtains were stretched whenever the vessel was in motion. After this there was an open chamber occupying the same room above that occupied by the portico before mentioned as being below, and a wind-

* See Bohn edition.

* See Bohn's edition, vol. iii.

ing ladder joined on to it leading to the secret walk, and a banqueting room capable of containing nine couches, constructed and furnished in the Egyptian style. Four round pillars were run up in it, with alternate tambours of white and black, all placed in parallel lines, and these heads were of round shape, and the whole of the figures round them were engraved like roses a little expanded. Round that part which is called the basket there were not tendrils and rough leaves, as is the case in Grecian pillars, but calyxes of the river lotus and the fruit of newly budding dates, and sometimes many other kinds of flowers were also represented. Under the roof of the capital, which lies upon the tambour where it joins on the head, there were ornaments like the flower leaves of the Egyptian bean intertwined together. This, then, is the way in which the Egyptians construct and ornament their pillars, and this is the way in which they variegate their walls with black and white bricks, and sometimes also they employ the stone which is called alabaster. There were many other ornaments all over the main hall of the vessel and over the center, and many other chambers and divisions in every part of it. The mast of this vessel was seventy cubits (one hundred and forty feet) in height, and it had a linen sail adorned with a purple fringe."

HEAVY TANK LOCOMOTIVES FOR THE INDIAN STATE RAILWAYS.

THE engines illustrated herewith were manufactured by Messrs. Neilson & Company, Hyde Park Locomotive Works, Glasgow, for the Muskaf Bolan section of the Northwest Indian State Railways, to the designs of Sir A. M. Rendell, Westminster. They are intended to work on gradients of 1 in 25, and will traverse curves of 600 ft. radius. The total weight of the engine in working order is over 92 tons, and as the greatest weight per axle is restricted to 17¼ tons, four pairs of coupled wheels are required to give the necessary adhesion for the cylinder power. The engine is capable of taking a load of 220 tons exclusive of its own weight up a grade of 1 in 25. In India the water in the tanks gets so hot that there is sometimes difficulty in feeding with the injectors; in addition, therefore, to one injector, a donkey pump capable of feeding the boiler with water at 180° is fitted to the engine.

The principal dimensions of the engine are as follows:

Diameter of cylinders	20 in.
Length of stroke	26 in.
Diameter of coupled wheels	4 ft. 3 in.
	Square feet.
Heating surface in tubes	1942
Heating firebox	148
Total	2090
Area of fire grate	30·22
Contents of tanks	2200 gallons
Fuel space	190 cubic feet
Fixed wheel base	16 feet
Total wheel base	31 ft. 3 in.
Boiler pressure	180 lb. per sq. in.

Weight with tanks full, two tons of coal in bunkers, and in working order:

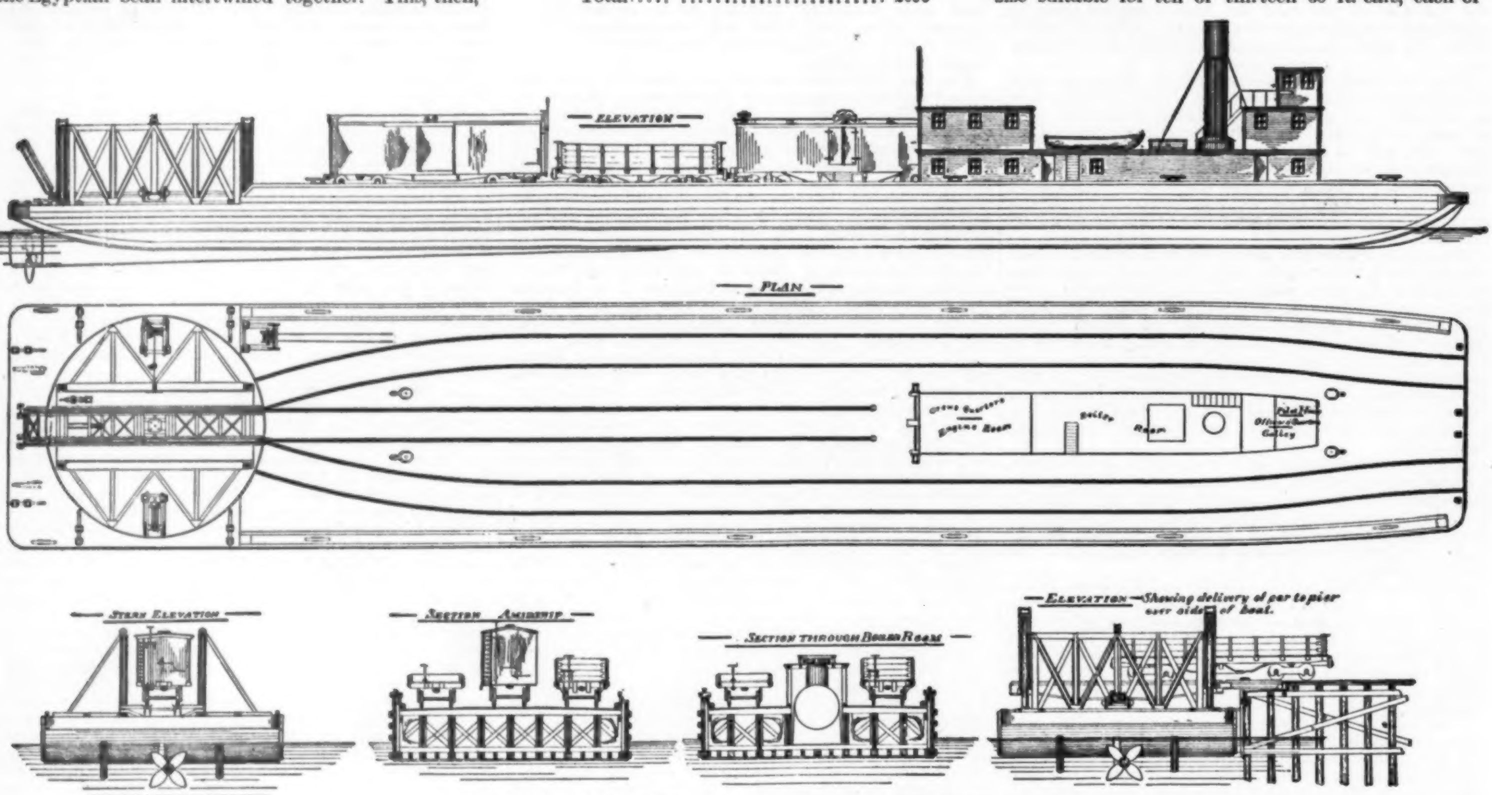
	Tons.	Cwts.	Qrs.
Leading radial	8	13	0
Leading coupled	17	8	1
Intermediate coupled	17	8	1
Driving	17	9	0
Trailing	17	6	3
Hind radial	13	16	2
	92	1	3

This is, we believe, the heaviest locomotive in the world.—The Engineer.

BERG'S SPECIAL DELIVERY CAR TRANSFER STEAMER.

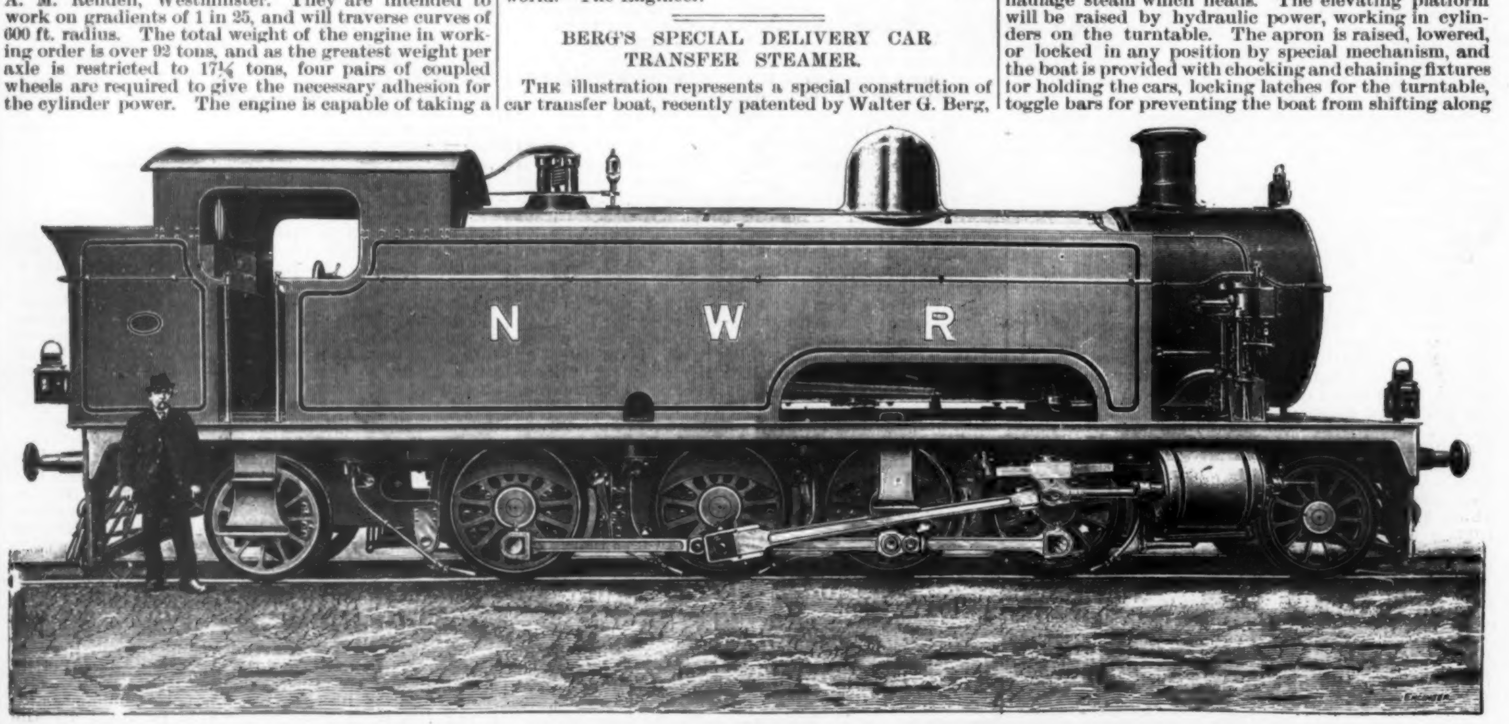
THE illustration represents a special construction of car transfer boat, recently patented by Walter G. Berg, member of the American Society of Civil Engineers, No. 261 West Fifty-second Street, New York City. The boat is provided with its own propelling machinery and with suitable mechanical appliances to allow a car on the boat to be raised to a proper height to be shunted ashore on a piece of track laid on the floor of the pier or bulkhead, which track need not be longer than necessary to hold a car or may be extended and carried into and through the consignee's establishment. By the special elevating and landing mechanism the car may be delivered either over the stern of the boat or on either side, cars being similarly transferred from land to the boat.

The illustration shows in plan, elevation and sectional views a transfer boat which may be made of a size suitable for ten or thirteen 38 ft. cars, each of 80,000 pounds capacity, in the latter case the boat being 38 ft. 6 in. wide and about 240 ft. long. The boat is to be propelled by a single screw driven by the usual class of marine engine and boiler at a speed of about ten miles an hour, and the extreme lift of the elevator is designed to be 10 ft. 6 in. As will be seen, the boat has on its deck three lines of railroad tracks, similar to those of the present car transfer boats, and at the stern of the boat is a turntable on which cars may be run from the tracks. The track on the turntable is supported by an independent platform that can be raised with the car on it above the deck of the boat, and lowered again to the deck of the boat at will. There is a swinging apron attached to one end of the platform, with suitable adjustable rail connections, etc., allowing a proper connection to be made with the rails of the track ashore. The turntable is designed to be turned by a wire rope winding drum, and the car may be moved along the deck to or from the turntable by rope haulage steam winch heads. The elevating platform will be raised by hydraulic power, working in cylinders on the turntable. The apron is raised, lowered, or locked in any position by special mechanism, and the boat is provided with chocking and chaining fixtures for holding the cars, locking latches for the turntable, toggle bars for preventing the boat from shifting along



SPECIAL DELIVERY CAR TRANSFER STEAMER.

United States Patent No. 576,941, February 9, 1897. Walter G. Berg, Patentee, 261 West Fifty-second Street, New York, N. Y.



HEAVIEST LOCOMOTIVE IN THE WORLD—TANK LOCOMOTIVE, INDIAN STATE RAILWAYS.

the pier, and moving fixtures for tying up to the shore. It is designed that the crew, coal consumption, and operating supplies will be practically about the same as required on a regular large tug boat carrying the same class of propelling machinery.

INGLIS' TRIPLE EXPANSION PADDLE-WHEEL ENGINES.

WE illustrate herewith a type of triple expansion engines which Messrs. A. & J. Inglis, of Glasgow, have fitted to several paddle-wheel steamers during the past ten years, attaining, with each, a full measure of success consistent with the long record of the firm. The first steamer fitted was the Ramapoora, completed in 1887 for service in Indian waters. Since then four other large vessels have been fitted with similar engines, and the firm have just completed engines of 600 indicated horse power for two steamers for the River Steam Navigation Company, of Calcutta, and three others for small vessels abroad are in hand. As an indication of the relative space occupied, it may be said that these latter new engines will actually occupy less width athwartship than the old compound engines originally in the vessels.

The engines illustrated are typical; since the first set was designed, only very slight alterations have been made. In the set placed in the Ramapoora the high pressure engine crank led, with the intermediate next, and the low pressure last; in subsequent cases the low pressure leads, followed by the intermediate and the high pressure. The practical results, either in respect of economy or efficiency, were not, however, affected by the change. In other respects the engines are identical. A noticeable point is that Messrs. Inglis have maintained their preference for the ordinary double eccentric motion, with Gooch's arrangement of stationary link, which has been so largely used in locomotive practice. To reverse the engine, the intermediate radius rod or link is shifted by means of the usual reversing shaft actuated by Brown's engine, so as to bring the quadrant block in line with the astern-going eccentric rod. It will be noticed that the suspension links oscillate on the reversing shaft as a center, and are coupled to the reversing quadrant at a point coincident with the attachment of the ahead-going eccentric rod. For an engine working generally in full gear ahead, this gives a smooth running gear with little motion of the block in the quadrant. Messrs. Inglis have adopted the Gooch stationary link gear for thirty years in paddle engines. It is interesting to note, in connection with the engines illustrated, that the firm have been able to get their triple engines into the steamer without adding to the space occupied by the compound engine, and that, too, without resorting to any but well-tried gear.

The engines of the paddle steamer Paris, built for the Messageries Fluviales del Plata, and illustrated by us, occupied a width over the casing of 20 feet; they were designed to develop 2,500 indicated horse power while running at about 32 revolutions. The Rasmara was a repeat order of the Ramapoora, the second ship being completed in March of 1890. The Paris was the third paddle steamer fitted by Messrs. Inglis for the River Plate Company, the first two, the Helios and Triton, being built by the Scotswood Shipbuilding Company, Newcastle, in 1892 and 1894 respectively. The other vessels were constructed at the Pointhouse yard of Messrs. Inglis.

The cylinders are steam jacketed, and the high pressure is fitted with a piston valve receiving steam in the inside, while the intermediate and low pressure cylinders have double ported slide valves arranged, as shown, on the outside, so that they can be easily overhauled. The pistons are of steel, with a special packing adopted by the firm and arranged to give the least possible friction. The piston rods and valve spindles are fitted with metallic packing. The piston rods are made from Siemens-Martin steel ingots, but the connecting rods are of malleable iron. The main columns are of forged steel, and are made so as to form the guides for the piston rods. The entablature is of steel, and the construction can be seen by reference to the illustrations. These points, it may be said, indicate the usual practice at the Whitehall foundry of Messrs. Inglis. The crankshaft is in one piece and 16¼ inches in diameter. It has long bearings of hard gun metal.

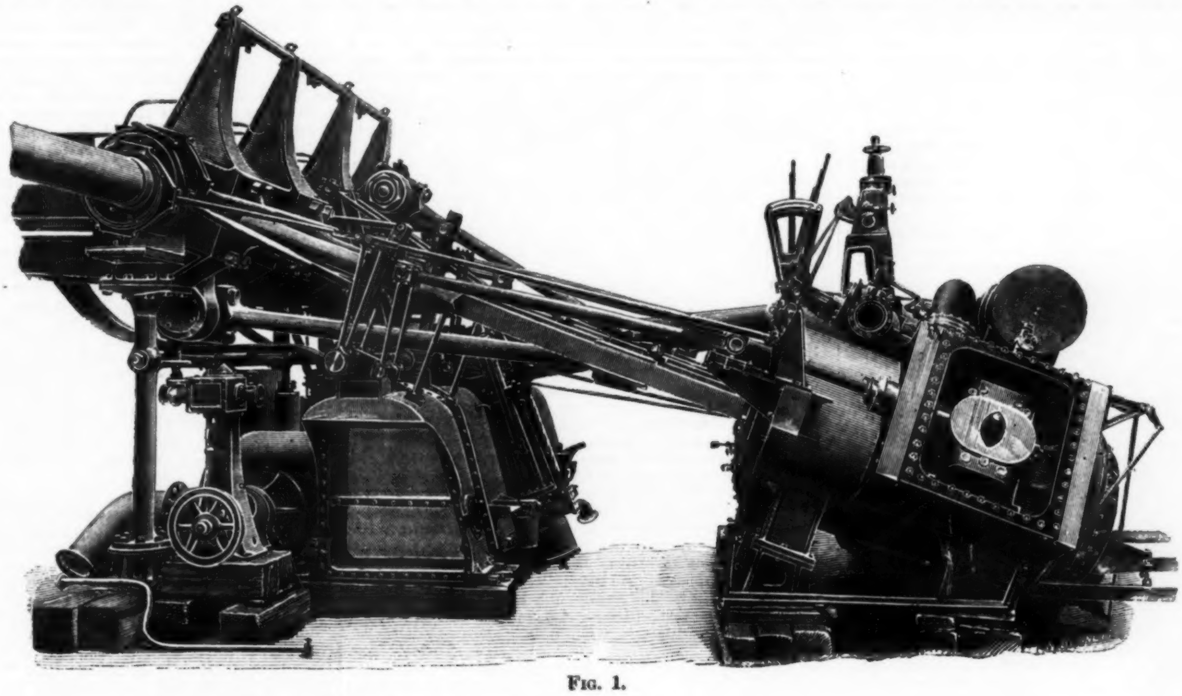


FIG. 1.

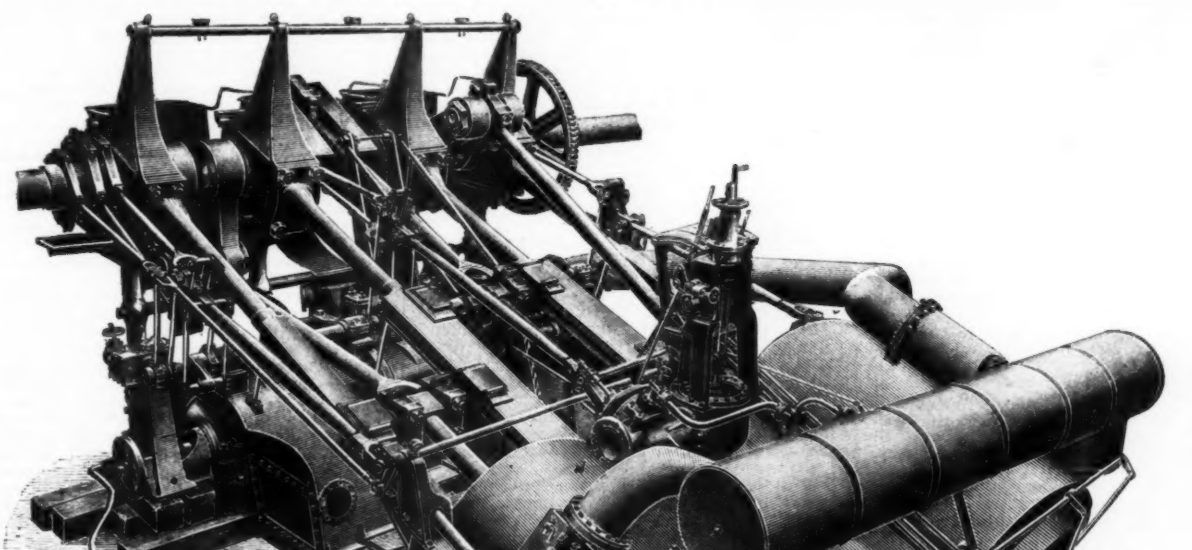


FIG. 2.—INGLIS TRIPLE-EXPANSION PADDLE ENGINES.

The wheel—arms and floats—is constructed of Siemens-Martin steel. The diameter is 21 feet over the floats, of which there are eight of 11 feet 6 inches width by 4 feet. Of course they are of the feathering type, and as is sometimes, although not invariably, the case with Messrs. Inglis' engines, there is no outer ring. This gives convenience in overhauling if it does not also minimize the repairs necessary after the wheel has collided with obstructions, when a ring is likely to get badly damaged.

The condenser is of cast iron and forms a support for the pumps and valve motion as shown. The tubes, ¾ inch in diameter, are of brass, and the tube plate, 1½ inch thick, is of Muntz metal. The air pumps are brass and are worked from the high pressure cross-head. The circulating pumps are of the centrifugal type, by Gwynne, and are driven by a separate engine.

In connection with the Paris it is interesting to state, although it is not shown on the drawings, that the cylinders are fitted with a special cut-off gear, so that the cut-off may be as early as 10 inches to 12 inches of the stroke in the high pressure cylinder. This is arranged by a drop double beat valve, actuated by an eccentric and slip catches driven from the main shaft. It may be brought into use at any time, almost instantly, whenever it is desired to have an early cut-off.

The four boilers fitted are single ended, the diameter being 11 feet and the length 11 feet 3 inches. There are eight furnaces, 3 feet 6 inches in diameter inside measurement, and the tubes are 2½ inches in diameter, the ratio of stay to fire tubes being 1 to 5. The grate area is 140 square feet and the heating surface 5,150 square feet. Howden's system of forced draught is fitted, and the boilers are arranged so that any two may be used independently of the others.

The trials of the Paris were conducted in mid-winter in squally weather, with the ship fully loaded. The results given are the mean of four runs on the measured mile: Indicated horse power, 2,200; revolutions, 32 per minute; speed, 16 knots. On a full power run 2,500 indicated horse power was exceeded.

To judge from the splendid finish of the saloons of the Paris, it is pretty evident that even in the unsettled regions which Europeans lump as South America, the trend is toward more luxurious surroundings afloat, and it is safe to assume that nothing like the Paris has as yet been seen on the Plate. Accommodation is provided chiefly for first-class passengers and for a few second-class. There are four decks — promenade, saloon, main and lower—and on the saloon and main decks one can accurately measure the advance on her predecessors which the new boat represents. The saloon deck shows the first-class Clyde shipbuilder at his best. The dining saloon and a large number of the staterooms are on this level, and, speaking broadly, the apartment from which access is obtained to them is the length and breadth of the ship. Amidships the engine space breaks the continuity, but forward of the obstruction there is a commodious and handsomely fitted dining saloon, and aft there is an apartment of similar size, which may be used as an auxiliary dining room, but will probably be utilized as what is termed on liners a "social hall." Wide corridors, in which are sofas and chairs, connect the two. The fittings throughout the ship are of the latest and most complete description, but on the saloon deck decorative art, as it is known in shipbuilding, is carried to very nearly perfection. The paneling is all in light wood, with hand-painted panels and a finely carved gilt cornice. The fanlights are also hand painted, and the glass panels of the stateroom doors are similarly treated. The sofas, chairs, etc., are upholstered in Utrecht velvet. There is a complete installation of electric light, so complete, indeed, that it supersedes even the candles on the piano in the forward saloon and in the organ in the after.

Among the novelties on board is a set of aluminum boats. The tackle blocks for lowering these are of the same metal, which is also largely used in some of the minor fittings usually classed as "ironmongery." Lightness and strength combined have been studied with unusual care, and to insure these qualities a large number of special sections of rolled steel have been employed in the construction.—Engineering.

INSECTICIDES AND HELPFUL AGENCIES.*

The florist has his share of the insect world to fight; in fact it seems as though he had much more than his share, for insects multiply the year round, and so very rapidly in the warm and humid atmosphere necessary to forced plant growth. Many of the insecticides in use on the farm cannot be used on house plants, because the later are too delicate and tender. This has given rise to a great many patented insecticides, or remedies, composed of unknown ingredients which are sold under attractive names at fabulous prices. Many of them are valuable and worth the price, while others are valueless or worse than nothing. After all, there are usually simple, cheap and efficient remedies to which we return after our vain search for a panacea among the compound mixtures.

Water.—The florist appreciates the value of this simple and often very effective agent in insect control. In wetting the plants, a hose with a good nozzle attachment is used, so that the water can be thrown with force upon all parts of the plants, and so beat off many of the little pests that are lurking under the leaves or on the stems. More than this is rarely needed for the red spider, and many of the aleyrodes and male mealy bugs are also killed by this method.

In a home conservatory, or in the home where only a few plants are kept, the above method is rarely practicable, but hot water is even a better antidote for these troubles than cold. If once thoroughly tested, it will be found to be most valuable; it is always at one's command, costs nothing, and with a few moments' heating is ready for application. The plant is left clean and free from any bad effect if the water is not raised to too high a temperature. From 130° to 135° F. is sure death to most insects, while few plants are harmed by water at 150° F., the scalding point. Even the coleus, one of the most delicate of plants, is not injured by water at 150° F. On the more hardy plants, such as the cabbage, we know that water at 180° F. does them no harm. By the use of a thermometer, heat the water to 140° or 150° F., and then dip the plants into it quickly two or three times. If preferable, use a sprinkler or spray pump without a nozzle; but remember that the water must strike the insects to affect them, and to be effectual it must be at a temperature between 130° and 150° F. when it strikes them. Water cannot be thrown in a spray, as it cools too rapidly.

Tobacco.—There is perhaps no other substance in such general use for insects in the greenhouse, particularly the aphis, as tobacco in its various forms. The waste or hard parts of the tobacco leaves, known as "stems," can be obtained from cigar factories for almost no cost, and are quite as valuable an insecticide as the more expensive tobacco. The use of it as a smoke or vapor is the only practical method of application. When wanted for fumigating, the stems should not be so dry that they will blaze, but rather smolder and generate a large volume of smoke. They may be moistened at the time of using, but preferably should be kept in a moderately damp place where they will be evenly moistened throughout. Occasionally tobacco dust may be secured as cheaply as the stems, and for burning this will be found superior to the stems in some respects. Probably the best time to fumigate is late in the afternoon on a still day, as too much wind outside will usually drive the smoke to some extent inside. This, too, will leave the tobacco fumes in the house overnight, and the full effect will be derived from them. The tobacco may be burned in various ways. Some use sheet iron buckets for holding the tobacco, others place it on the earth or cement floor and burn it there. The Elmira (N. Y.) florist, Mr. Grove P. Rawson, writes that an occasional shovelful of live anthracite coals from the furnace spread over the tobacco dust serves him the best of anything. The amount of tobacco to be used and the frequency in using must be left largely with the operator in each individual case, as the kind of plant to be treated, the tightness of the house, the strength of tobacco, and the abundance and kind of insects all tend to vary the amount and time.

Within the past two or three years vaporized tobacco has largely superseded tobacco fumes. By those who have tested both, the vapor is considered much superior and more effective on the aphis. Where steam is used for heating, the treatment is very simple. The tobacco stems are placed in a kettle or barrel; a hose is then connected with one of the steam pipes, the other end is inserted into the kettle, and the steam does the rest. The house is very quickly saturated with the tobacco vapor and the work soon over. Surplus moisture of course is the item to be feared in this treatment, and to prevent mildew, florists are generally agreed that the treatment should be given early in the morning on a bright day, and as soon as it is finished the plants should have their regular syringing and the house be ventilated.

Another method of vaporizing that has many adherents is to apply liquid tobacco directly to the outer surface of the steam pipes and allow it to evaporate. The Louisville Spirit-Cured Tobacco Company, of Louisville, Kentucky, recommend this method for the use of their liquid tobacco extract, and it has given excellent satisfaction as far as we have been able to ascertain.

Our college greenhouse is heated by hot water, and with us the vaporization of tobacco is not as practicable as fumigation, owing to the pipes remaining at too low a temperature. A fair substitute for steam is a hot brick dropped into the liquid extract. Evaporating over an oil stove is too slow to be recommended.

Kerosene Emulsion.—For the hardy ornamental plants out of doors and the more hardy ones indoors, kerosene emulsion may be used. On the more delicate plants it must be used with great caution, if at all. There is quite a question in the mind of the author whether it should be even recommended when there are other good and safer oil and soap washes that may be substituted.

For those who care to use the emulsion, the following formula may be followed:

Soft Soap Formula.—Heat a gallon of soft soap until it becomes liquid; then take from the fire, add two quarts of kerosene and agitate for three or five minutes so thoroughly that the soap and oil become permanently mixed—that is, until the oil will not separate from the soap either on standing or when diluted. A hand force pump should be used in making the emulsion. Slow pumping or stirring with a stick or spoon will not emulsify the soap and oil.

The emulsion as made is now one-third oil, and for the plants it should be only one-fifteenth oil. So it will need four times its own bulk of water before using. In other words, the gallon of soap and two quarts of oil will make seven and one-half gallons of the dilute emulsion.

If the emulsion is to be made in the above or greater quantity, it should always be made with soft soap, if that is obtainable, as the emulsion is more difficult to make by the hard soap formula, where more water is required.

Hard Soap Formula.—To two quarts of water add one-fourth pound of hard soap, heat to the boiling point, and when the soap is dissolved add the pint of kerosene and proceed as in the soft soap formula. This is one-fifth oil and should be diluted with twice its own bulk of water before using.

Fir Tree Oil.—This is a penetrating oily liquid which is one of the best insecticides that we have found for such insects as the mealy bug, thrips, red spider, aleyrodes, and young scale. It can be procured through florists or dealers in florists' goods. The cost is one dollar per quart. This is rather high priced, but when one has but a few plants the treatment will not be expensive. When used at the rate of one-half pint to a gallon of water there is danger of injuring the most delicate plants. At the rate of two-thirds of a pint to a gallon of water ferns are the only plants on which we have tested it that are injured. This last proportion is much more effective on mealy bugs and aleyrodes than the weaker mixtures. One of the great pleasures derived from the use of this mixture, besides that of killing the insects, is the fine condition in which it leaves the foliage. There is a bright, clean luster that reminds one of new foliage.

Some florists apply the undiluted oil on the scale insects with a small brush and find it very successful, though a little slow.

Fir Tree Oil Soap.—This is a soap prepared from the fir tree oil and is sold, as far as we know, only by J. C. Pierson, of Newark, N. J. It has all the qualities of the fir tree oil, and, if anything, can be used stronger on the plants than the oil without injury to them. It should be used from three to five times as strong as recommended by the agency to secure the best effect, or, in other words, from three to five ounces to each gallon of water. This makes the expense about ten to fifteen cents per gallon, which is, at that strength, less than the cost of the oil. The soap dissolves readily in soft water upon heating slightly, and leaves the foliage with a glossy luster.

Whale Oil Soap.—We used the whale oil soap in comparison with the last two substances, and find that, while it is much cheaper than either of them, it is also inferior in several respects. If made strong enough to be as destructive to insect life, it is more liable to injure the foliage of the more tender plants, and when used very strong it leaves the foliage more dirty and with white, soapy, mildewlike spots on the leaves. When used at the rate of one-fourth pound to a gallon of water there was no injury to plants; one-half pound to a gallon injured the foliage of several tender plants.

Soft water should be used with all of these soap and oil washes.

Cole's "Insect Destroyer."—Professor Comstock says of this in the United States Agricultural Report for 1880: "An analysis of it shows that it may be closely copied by dissolving 2 to 2·5 per cent. of green soap in 100 parts of 50 per cent. alcohol." The material is prepared ready for use when purchased, and is sprayed upon the insects with a hand atomizer. It is harmless to the plant, but we have found it rather inferior to the oil and soap washes in its effect upon mealy bug and young scale. When applied, appearances would lead one to think that the destruction of insects was complete, but a later examination will show that quite a share of them recover. The cost is about ninety cents or a dollar a pint.

Hydrocyanic Gas.—At present we cannot recommend its use, except with the greatest caution. One should also remember that it is a strong poison.

Bisulphide of Carbon.—Very good success has been attained in treating red spider and aphis with this gas. Were there not other remedies simpler, cheaper and as effective on these insects, it would no doubt form one of our valuable greenhouse insecticides. As it is, there is too much risk to run from injury to the plants in treating them in this way for the extra benefit derived over tobacco vapor for the aphis, and water or the oil and soap washes for the red spider. To be used on plants they must be placed in a tight box, barrel, or other receptacle. The bisulphide is then introduced in a shallow dish or on cotton batting at the rate of about nine or ten drops per cubic foot of space. Keep the box closed for about two hours.

Flowers of Sulphur.—As a partial insecticide and a good fungicide, sulphur is a desirable substance to use in the greenhouse. It is also destructive to plant life when too much is used, and hence care and experience are needed in its use. Some florists claim good results on red spider from a small quantity of sulphur dropped on a hot shovel and held beneath the mite-infested plant until the odor becomes strong in that vicinity. The usual method is to mix with an equal bulk of air-slaked lime, make it into a thick paste by addition of water, and then spread upon the heating pipes or furnaces.

Lime.—For insects that live in the soil and feed on the roots of plants, alkaline substances, such as air-slaked lime or wood ashes mixed with the soil, give very satisfactory results. They are also considered among the most valuable remedies against eel worms and slugs. Florists differ as to the amount that gives the best results, the range being from a coating an inch thick to a slight white covering of the soil. A conservative average, or less than half an inch coating, would seem nearest right, but this depends greatly upon the depth of the soil on the benches. The lime should be thoroughly mixed with the soil before transplanting to it.

Wood Ashes and Soot.—These substances are good substitutes for air-slaked lime when unleached, but in a fresh state they cannot be used as freely in the soil. Even if they are of no direct benefit in repelling insects, they are of indirect value in supplying potash.

Paris Green.—There are a few insects on house plants against which we can use the arsenites with good effect. Paris green is less apt to injure the foliage than the other arsenites, as there is less soluble arsenic in it. A quarter of an ounce to three gallons of water is as strong as it should be used. If a little strong lime water is added, there will be no danger of injuring tender plants, as all the arsenic in the Paris green then becomes insoluble.

Toads.—The toad is a great insect destroyer and is well worthy the protection of florists. He is actively engaged in catching his prey throughout almost the entire year, and as his work is done mostly at night and on cloudy days, he catches a great many of the night marauders, such as slugs, millipeds, and cutworms. All that he needs is a small pile of loose soil in which to burrow and a cool place under the bench in which to retreat.—Bulletin of Pharmacy.

* Excerpt from Special Bulletin No. 2, Michigan Agricultural College.

Buyers and users of metal roofing and siding have had a tendency toward lighter gages in recent years. This is probably due to the smaller cost and is in line with the general disposition for lower priced goods, even when the difference is very slight. Two gages are now in common use, Nos. 26 and 28, with only infrequent demand for No. 27, but I think that most manufacturers would recommend the use of No. 24 if it were not for the tendency in question. The added cost is not material when the extra weight and wearing qualities are considered. At the same time that lighter gages came in vogue there was noted an increased movement in favor of galvanized sheets and a change from iron to steel, while these are really the most marked changes that have been made in this branch of roofing in the past ten years. Metallic lathing has been introduced in that time, but this is an individual branch of the business and has no direct bearing on the other question.—Stoves and Hardware Reporter.

ELECTRICAL NOTES.

The King of Siam has granted a franchise for an electric lighting plant in Bangkok to an American firm.

The Russian Electro-technical Association will hold an International Electrical Exhibition in St. Petersburg during the summer of 1899. All the principal electro-technical industrial concerns will be invited to participate in the exhibition, for which considerable success is foreshadowed.

Belgrade, the capital of Servia, is now to be supplied with a system of telephone lines. Four hundred customers have already subscribed, and the construction will shortly be taken up by the firm of I. Berliner, of Vienna, who, out of several applicants, have been successful in securing the contract. — Electrotechnische Rundschau.

A Reuter telegram states that during a thunder storm which passed over the district of Rosenheim, Bavaria, recently, a powder factory near Stephanskirchen was struck by lightning. A large quantity of powder, amounting to 11,000 lb., exploded, and 11 houses were shattered. The force of the explosion was such that large trees were torn up by the roots. In Rosenheim, which is about four miles distant from the scene of the explosion, and in Stephanskirchen, which is over a mile off, doors were burst from their hinges and windows from their frames, and in some cases broken. Only one workman at the factory is said to have been injured, and that not seriously.

A large electric installation has recently been completed at Rovos, Norway, says Engineering. There are two large alternate current dynamos, with a tension of 5,000 volts. The dynamos are directly coupled with the turbines, each of 300 horse power. The current is conveyed from the machinery house by means of bright copper wires to three copper mines, some 5 to 7 miles distant, and is there transformed to 150 volts. The electricity is used both for lighting purposes and for working a considerable amount of machinery. A separate dynamo supplies the requisite electricity for the electric railways. Every precaution has been taken to prevent accidents, the wires being protected where the surroundings make this necessary. The height of the fall is about 50 ft.

United States Consul Morris, writing from Ghent, April 16, gives details of the proposed construction of an electric street railway system in that city. The franchise includes all the lines proposed for the entire city, and will be sold to the highest bidder at a fixed annual rental to be paid to the city for a certain term of years, at the expiration of which the city reserves the privilege of purchasing the entire system. The motive power will be electricity, the accumulator to be used in the central portion of the city, and in the outlying districts the trolley system. The fare for first class passengers will be three cents and for second class two cents. The employes will work from thirteen and a half to fourteen and a half hours a day, and the wages for motormen, conductors and workmen are fixed at 72½, 69½, and 58 cents per day, respectively. The final award of the franchise will be made on or about July 1.

Capt. Lampe, of the steamship Leon, which arrived at New York City recently with fruit from Jamaican ports, tells a story of a remarkable electric storm encountered while his vessel was off Cape Hatteras. The steamer, according to the skipper's story, was plowing along through a smooth sea, with clear weather overhead, when suddenly, with scarcely any barometric warning, jet black clouds gathered on the horizon, and with almost incredible swiftness mounted into the heavens, accompanied by the constant and terrific booming of thunder and flashes of lightning. The three women passengers on the steamer were almost hysterical from fright. For almost five hours the little vessel groped her way along. All the time the sea was as smooth as glass. The climax of the storm occurred when a great bolt of lightning shot over the bow of the Leon and struck the water fifty yards away with terrific force. An immense volume of water was thrown into the air to a height of fifty feet, deluging the deck of the steamship with spray. Then the rain fell in torrents. The officers of the Leon believe that the water that fell on the vessel was from a cloudburst. The water came, not in drops, but in sheets and columns. The crew were unable to stand the deluge on deck, and all hands were ordered below. Suddenly the clouds lifted, and within a short time there were left the usual summer sky and sea.

A writer in the Iron Age speaks of the trolley as a "dangerous feature for the smaller dealers" in hardware, because it enables the farmer, who was formerly tied down to the general local store, to reach easily the larger centers of trade. "It did not pay the inhabitants of small cities to spend $3 to $4 for the purpose of purchasing about the same amount in a large neighboring city, especially when the number of trains was limited, and when it consumed a whole day and well into the night to make the journey. But now the electric car stops at the farmer's door, suburban cars leave every thirty minutes, they carry express packages, and they take much of the local trade to neighboring cities. The small country dealer is the greatest sufferer. He loses his cash customer and retains those whom he has to carry and who have no ready money. The larger towns gain from the country what trade they lose to the cities, while the cities have nothing to lose." It strikes us from a different point of view. The very fact that the trolley cars deliver express packages should enable the small general store in a village to carry practically a much larger stock than ever before and to fill many wants that previously were not felt or went unsatisfied because of the distance from market. Besides, accessibility always promotes trade and intercourse, and this ought to be a good thing for the small country dealer, particularly if the trolley brings into his neighborhood a number of residents, earning good weekly cash salaries, to whom the real country was formerly out of reach. Heretofore the small dealer has presumed on his inaccessibility, and made it an excuse for not handling a number of useful and desirable things. The trolley gives him a genuine opportunity of new life. But if he supinely lies down to die, he will die before he is dead, and someone else will see the modern chances and find a profitable way out.

MISCELLANEOUS NOTES.

The United States of Brazil issued 200 patents in 1896, of which 111 were secured by Brazilians, 22 by Americans, the same number by Englishmen, 16 by Frenchmen, and 14 by Germans.—La Propriété Industrielle.

Mulhausen (Alsace) shows a remarkable increase in population; in the 20 years from 1875–1895, the number of inhabitants has risen from 58,463 to 83,040, i. e., 42 per cent. This is mainly due to the growth of the manufactures, and a correspondingly increased demand for workmen.—Uhland's Wochenschrift.

Mr. Vennkoff informs the Geographic Society of Paris that the Araxes (Transcaucasia), restored to its ancient course, now flows directly into the Caspian Sea, and is thus no longer a tributary of the Kura. As this change is considered favorable by the inhabitants, the government has been requested to take measures to render the present state of things permanent.—Die Umschau.

Hitherto calcium carbide was prepared by fusing lime and coke together in a Moissan and Willson electric furnace. But this process, even if the required force can be supplied by a watercourse, is rather costly, so that a cheaper process, patented by Pictet, is likely to prove very useful. He introduces the lime and coke in a furnace and acts with the electric arc at the bottom only. The coke begins to burn, and, by the aid of a blast of hot air, raises the whole mass to a very high temperature, so that but little additional heating on the part of the arc is required. This improvement is of great importance, because it will make acetylene a dangerous rival to our ordinary coal gas, which it far exceeds in luminosity.—Electrotechnische Rundschau.

A patent has been applied for in Belgium for an incombustible lampwick. This is made of glass, and it is traversed by fine channels. The lamp is lit automatically, the oil being drawn up the channels by atmospheric pressure. It is urged as one of the main advantages of the invention, besides the incombustibility of the burner, that the supply of oil is uniform, so that a flickering flame and the result of such, the cracking of chimneys, are avoided. It seems, however, that on the one hand the making of such wicks offers difficulties, and on the other even refined kerosene oil leaves solid residues which would in time stop up the pores, and danger of explosion would arise.—Uhland's Wochenschrift.

We give a description of a new procedure for condensing milk into a semi-solid or a powder.

The milk is first frozen, being continually kept in motion, so that the ice crystals may separate out. By means of a centrifugal separator the milk is then obtained free from ice. This process is repeated until the product contains 80–95 per cent. solid constituents. The milk is then sterilized and concentrated in vacuo at a temperature of 38° Centigrade. Into the vacuum carbon dioxide is admitted, and the pasty mass is cast into forms. When solid it is hacked up, finally dried in carbon dioxide, cooled to 0° Centigrade, and powdered. The powder is packed in hermetically sealed jars which contain carbon dioxide.—Uhland's Wochenschrift.

An immense block of granite, having a given weight of not less than 1,217 tons, was recently put in place at St. Petersburg as the pedestal for the new statue of Peter the Great, the block having been transported four miles by land over a railway and thirteen miles in a caisson by water. The railway consisted of two lines of timber furnished with hard metal grooves, between which grooves were placed spheres of hard brass about six inches in diameter; on these spheres the frame with its load was easily moved by a force of sixty men working at the capstans with treble purchase blocks. Another large block, measuring thirty-five by sixteen by fourteen feet, is reported to have been taken out, a few months since, from the Craigneth quarries, near Dalbeattie, Scotland, the block weighing 650 tons.

Wm W. Astor entertained his guests at a dinner in London, England, not long ago, with stories of the big trees in California. Some of his hearers professed to be skeptical, whereat Mr. Astor offered to wager that he could have prepared from one cross section of a California tree a table sufficiently large to accommodate at dinner the forty guests then assembled, or others to that number. The wager was accepted. The sequel is transpiring. There was shipped at San Francisco recently a redwood section, cut from a tree 14 ft. 4 in. in diameter, consigned to "W. W. Astor, London, England." The piece of timber is 3 ft. thick and weighs 19 tons. Given time, and safe voyage to the good ship, Mr. Astor will entertain forty or more guests around a table constructed of this product of the forests of Humboldt County, Cal., and win his wager, at the same time impressing an object lesson on his insular cousins to the glorification of the United States.

A demonstration of the fire resisting properties of timber, prepared in accordance with a process recently patented in America, has been given in England. Two small houses, each of identical shape and dimensions, and fitted with wooden chimneys, but constructed in the one case of ordinary and in the other of treated timber, were exposed to the flames of a large bonfire piled against the windward side of each of the two buildings. The first named caught fire immediately, and collapsed in the course of half an hour, while the other stood the ordeal almost unharmed. Finally, a second fire was lighted inside this building, the chimney of which created a fierce draught. The structure, however, remained quite intact, and the wood, though it charred somewhat, entirely refused to burst into flame. The treatment consists in first thoroughly desiccating the timber in vacuo and then impregnating it under pressure with certain salts, the nature of which was not disclosed. The appearance of the timber and its working qualities are scarcely affected. In fact, it takes a polish somewhat more readily after treatment than before, as the pores of the timber are filled in the process. The battle of Yalu showed the importance of abolishing inflammable material on board warships, while the comfort of the officers and crew are equally bound up in the maintenance of a wood finish for their quarters. If the expense of the process does not prove prohibitive, a fairly large field should, we think, be open to it in this direction, and we note that it has been adopted somewhat extensively by the government of the United States.

SELECTED FORMULÆ.

The Preservation of Animals.—In a recent number of Natural Science there is given a summary of the observations of Mr. Amyrald Haly, director of the museum of Colombo, upon the value of formaline as an agent for preserving zoological specimens. According to Mr. Haly, who has been using this material for the last two years, a 1½ or 2 per cent. solution suffices to preserve the invertebrates in general. For the vertebrates it requires a 3 or 3½ per cent. solution. Formaline preserves the Medusae admirably, their colors and transparency remaining unchanged. Mr. Haly confesses, however, that formaline is not of universal application, for sometimes it fails. For fish of bright colors it is better to use gum and glycerine, and the same is the case with crustacea; but perhaps gum and formaline mixed might be used with advantage.

Cleansing Fluid for Aluminum Ware.—A solution of 30 grammes of borax in 1 liter of water containing a few drops of aqua ammonia.

Varnish for Aluminum Bronze.—The liquid which is sold in the United States under the trade name of the light Japan gold size is the best varnish to use with powdered aluminum bronze. This, however, is not the same article as is sold in England under the name of the gold size, and the best of these varnishes is made by taking 50 pounds of Kauri and 50 pounds of Zanzibar resin, together with 5 gallons of refined linseed oil, cooking these at a high temperature until there is no free oil left. This mixture should then be thinned down with a proper amount of turpentine (about 25 or 30 gallons), and then a drier should be added.—Aluminum World.

Preserving Tomatoes.—Take the best, firmest, and not over-ripe fruits, scald and skin carefully, take the stem out with a penknife, being careful not to cut the tomato and let the juice out; place in a jar, some with the stem and some with the flower end next to the glass. Cook some juice, adding a little salt, and pour over the whole tomatoes until the jar is nearly full. Place the jars in a common fish boiler of oblong shape, with a cloth at the bottom to protect them from the heat of the fire, which is liable to crack them. Fill the boiler with cold water and bring to nearly boiling point, or sufficient to heat the tomatoes clear through, and seal the jars. In about five minutes take off the jar cover to let gas out and allow the tomatoes to settle; then fill up with boiled juice and seal again. Next day screw the tops tight and put away in a dark, cool place.—Agricult. Journ., x, 320.

Insecticide for Plant Lice.—An effective insecticide for various insect pests on greenhouse plants is composed of the following:

Take of

Methylated spirit	200	parts.
Soft soap	20	"
Quassia wood	6	"
Salicylic acid	2½	"

Macerate for several days; dilute with sufficient water, and apply to the infested parts by means of a brush. Allow to dry on; the following day wash off with plenty of water.—Rev. Méd. Pharm.

Antiseptic Mouth Wash.—The Presse Médicale contains the following formula:

Thymol	4	gr.
Benzoic acid	14	"
Tincture of eucalyptus	225	"
Essence of peppermint	9	"
Chloroform	15	"
Alcohol	3	"

M. Twenty drops of this solution in a glass of water may be used at a time.

Mothol.—A pleasant deodorizer and moth preventive.

Alcohol	40	oz.
Tincture of capsicum	5	"
Naphthalene	1	"
Absolute phenol	1	"
Menthol	½	"
Oil of lemongrass	½	"

Mix and filter. To be used in the form of spray by means of an atomizer where the moths frequent.—Bulletin of Pharmacy.

Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Photo. Jl.)

Chalk Bath.—

Water	100 c. cm.
Chloro-aurate of potassium	1 grm.

For use—

Above solution	10 c. cm.
Water	115 "
Whitening	1 grm.

Mix and shake thoroughly at least twelve hours before use.

Toning Bath (Acetate of Soda).—

Water	2 liters.
Chloride of gold	1 grm.
Acetate of soda	30 "

Crystallized acetate of soda gives warm red tones; fused, bluish tones. The latter bath must be made up twenty-four hours before use.

Toning Bath (Borax).—

Water	1 liter.
Borax (fused)	8 grm.
Chloride of gold	1 "

Toning Bath (Chloride of Lime).—

Acetate of potassium	12 grm.
Chloride of lime	3 "
Carbonate of potash	6 "
Distilled or boiled water	480 c. cm.

Above is to be well shaken, then allowed to settle, decanted and filtered through cotton.

For use—

Above stock solution	320 c. cm.
Distilled or boiled water	3 liters.
Chloride of gold	1 grm.

This bath keeps well and may be used until the gold is entirely exhausted, Prints should be printed up strong.

SIGNALING THROUGH SPACE WITHOUT WIRES.*

By W. H. Preece, C.B., F.R.S.

Science has conferred one great benefit on mankind. It has supplied us with a new sense. We can now see the invisible, hear the inaudible, and feel the intangible. We know that the universe is filled with a homogeneous continuous elastic medium which transmits heat, light, electricity, and other forms of energy from one point of space to another without loss. The discovery of the real existence of this "ether" is one of the great scientific events of the Victorian era. Its character and mechanism are not yet known by us. All attempts to "invent" a perfect ether have proved beyond the mental power of the highest intellects. We can only say with Lord Salisbury that the ether is the nominative case to the verb "to undulate." We must be content with a knowledge of the fact that it was created in the beginning for the transmission of energy in all its forms, that it transmits these energies in definite ways and with a known velocity, that it is perfect of its kind, but that it still remains as inscrutable as gravity or life itself.

Any disturbance of the ether must originate with some disturbance of matter. An explosion, cyclone or vibratory motion may occur in the photosphere of the sun. A disturbance or wave is impressed on the ether. It is propagated in straight lines through space. It falls on Jupiter, Venus, the earth, and every other planet met with in its course, and any machine, human or mechanical, capable of responding to its undulations indicates its presence. Thus the eye supplies the sensation of light, the skin is sensitive to heat, the galvanometer indicates electricity, the magnetometer shows disturbances in the earth's magnetic field. One of the greatest scientific achievements of our generation is the magnificent generalization of Clerk-Maxwell that all these disturbances are of precisely the same kind, and that they differ only in degree. Light is an electromagnetic phenomenon, and electricity in its progress through space follows the laws of optics. Hertz proved this experimentally, and few of us who heard it will

WILLIAM MARCONI, INVENTOR OF THE APPARATUS FOR TELEGRAPHING WITHOUT WIRES.

forget the admirable lecture on "The Work of Hertz" given in this hall by Prof. Oliver Lodge three years ago.

By the kindness of Prof. Silvanus Thompson I am able to illustrate wave transmission by a very beautiful apparatus devised by him. At one end we have the transmitter or oscillator, which is a heavy suspended mass to which a blow or impulse is given, and which, in consequence, vibrates a given number of times per minute. At the other end is the receiver, or resonator, timed to vibrate to the same period. Connecting the two together is a row of leaden balls suspended so that each ball gives a portion of its energy at each oscillation to the next in the series. Each ball vibrates at right angles to or athwart the line of propagation of the wave, and as they vibrate in different phases you will see that a wave is transmitted from the transmitter to the receiver. The receiver takes up these vibrations and responds in sympathy with the transmitter. Here we have a visible illustration of that which is absolutely invisible. The wave you see differs from a wave of light or of electricity only in its length or in its frequency. Electric waves vary from units per second in long submarine cables to millions per second when excited by Hertz's method. Light waves vary per second between 400,000,000,000 in the red to 800,000,000,000 in the violet, and electric waves differ from them in no other respect. They are reflected, refracted, and polarized, they are subject to interference, and they move through the ether in straight lines with the same velocity, viz., 186,400 miles per second—a number easily recalled when we remember that it was in the year 1864 that Maxwell made his famous discovery of the identity of light and electric waves.

Electric waves, however, differ from light waves in this, that we have also to regard the direction at right angles to the line of propagation of the wave. The model gives an illustration of that which happens along a line of electric force; the other line of motion I speak of is a circle around the point of disturbance, and these are called lines of magnetic force. The animal eye is tuned to one series of waves, the "electric eye," as Lord Kelvin called Hertz's resonator, to another. If electric waves could be reduced in length to the forty-thousandth of an inch, we should see them as colors.

One more definition and our ground is cleared. When electricity is found stored up in a potential state in the molecules of a dielectric like air, glass or gutta percha, the molecules are strained, it is called a charge, and it establishes in its neighborhood an electric field. When it is active or in its kinetic state in a circuit, it is called a current. It is found in both states, kinetic and potential, when a current is maintained in a conductor. The surrounding neighborhood is then found in a state of stress, forming what is called a magnetic field.

In the first case the charges can be made to rise and fall and to surge to and fro with rhythmic regularity, exciting electric waves along each line of electric force, at very high frequencies, and in the second case the currents can rise or alternate in direction with the same regularity, but with very different frequency, and originate electromagnetic waves whose wave fronts are propagated in the same direction.

The first is the method of Hertz, which has recently been turned to practical account by Mr. Marconi, and the second is the method which I have been applying, and which, for historical reasons, I will describe to you first.

In 1884 messages sent through insulated wires buried in iron pipes in the streets of London were read upon telephone circuits, erected on poles above the housetops 80 feet away. Ordinary telegraph circuits were found in 1885 to produce disturbances 2,000 feet away. Distinct speech by telephone was carried on through one-quarter of a mile, a distance that was increased to 1¼ miles at a later date. Careful experiments were made in 1886 and 1887 to prove that these effects were due to pure electromagnetic waves and were entirely free from any earth conduction. In 1892 distinct messages were sent across a portion of the Bristol Channel, between Penarth and Flat Holm, a distance of 3·3 miles.

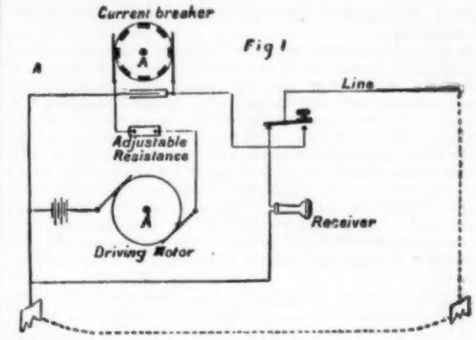
Early in 1895 the cable between Oban and the Isle of Mull broke down, and as no ship was available for repairing and restoring communication, communication was established by utilizing parallel wires on each side of the channel and transmitting signals across this space by these electromagnetic waves.

The apparatus (Fig. 1) connected to each wire consists of: (a) A rheotome or make and break wheel, causing about 260 undulations per second in the primary wire. (b) An ordinary battery of about 100 Leclanche cells, of the so-called dry and portable form. (c) A Morse telegraph key. (d) A telephone to act as receiver. (e) A switch to start and stop the rheotome. Good signals depend more on the rapid rise and fall of the primary current than on the amount of energy thrown into vibration. 260 vibrations per second give a pleasant note to the ear, easily read when broken up by the key into dots and dashes.

In my electromagnetic system two parallel circuits are established, one on each side of a channel or bank of a river, each circuit becoming successively the primary and secondary of an induction system, according to the direction in which the signals are being sent. Strong alternating or vibrating currents of electricity are transmitted in the first circuit so as to form signals, letters, and words in Morse characters. The effects of the rise and fall of these currents are transmitted as electromagnet waves through the intervening space, and if the secondary circuit is so situated as to be washed by these ethereal waves, their energy is transformed into secondary currents in the second circuit, which can be made to affect a telephone, and thus to reproduce the signals. Of course their intensity is much reduced, but still their presence has been detected, though five miles of clear space have separated the two circuits.

Such effects have been known scientifically in the laboratory since the days of Faraday and of Henry, but it is only within the last few years that I have been able to utilize them practically through considerable distances. This has been rendered possible through the introduction of the telephone.

Last year—August, 1896—an effort was made to establish communication with the North Sandhead (Goodwin) Lightship. The apparatus used was manufactured by Messrs. Evershed & Vignoles, and a most ingenious relay to establish a call was invented by Mr. Evershed. One extremity of the cable was coiled in a ring on the bottom of the sea, embracing the whole area over which the lightship swept while swinging to the tide, and the other end was connected with the shore. The ship was surrounded above the water line with another coil. The two coils were separated by a mean distance of about 200 fathoms, but communication was found to be impracticable. The screening effect of the sea water and the effect of the iron hull of the ship absorbed practically all the energy of the currents in the coiled cable, and the effects on board, though perceptible, were very



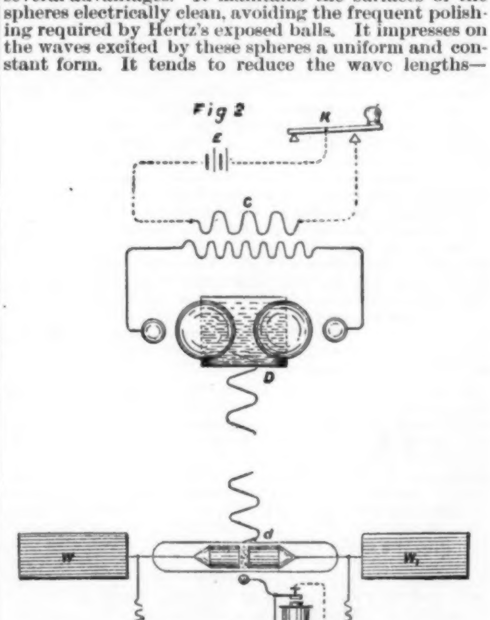
trifling—too minute for signaling. Previous experiments had failed to show the extremely rapid rate at which energy is absorbed with the depth or thickness of sea water. The energy is absorbed in forming eddy currents. Although this experiment has failed through water, it is thoroughly practical through air to considerable distances, where it is possible to insert wires of similar length on each side of the distance to be crossed. It is not always possible, however, to do this, nor to get the requisite height to secure the best effect. It is impossible on a lightship, and on rock lighthouses. There are many small islands—Sark, for example—where it cannot be done.

In July last Mr. Marconi brought to England a new plan. My plan is based entirely on utilizing electromagnetic waves of very low frequency. It depends essentially on the rise and fall of currents in the primary wire. Mr. Marconi utilizes electric or Hertzian waves of very high frequency, and they depend upon the rise and fall of electric force in a sphere or spheres. He has invented a new relay which, for sensitiveness and delicacy, exceeds all known electrical apparatus.

The peculiarity of Mr. Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used.

The Transmitter.—His transmitter is Prof. Righi's form of Hertz's radiator—see Fig. 2. Two spheres of solid brass, 4 in. in diameter—A and B—are fixed in an oil tight case of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. The use of oil has several advantages. It maintains the surfaces of the spheres electrically clean, avoiding the frequent polishing required by Hertz's exposed balls. It impresses on the waves excited by these spheres a uniform and constant form. It tends to reduce the wave lengths—

Fig 2



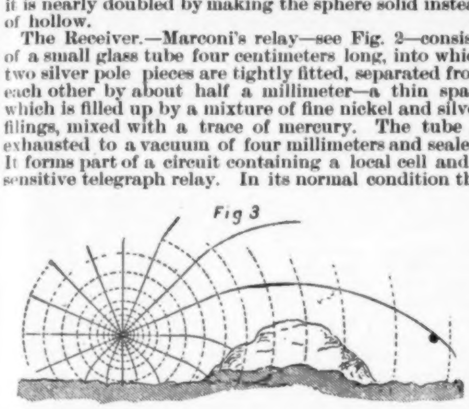
Righi's waves are measured in centimeters, while Hertz's were measured in meters. For these reasons the distance at which effects are produced is increased. Mr. Marconi uses generally waves of about 120 centimeters long. Two small spheres, a and b, are fixed close to the large spheres and connected each to one end of the secondary circuit of the "induction coil," C, the primary circuit of which is excited by a battery, E, thrown in and out of circuit by the Morse key, K. Now, whenever the key, K, is depressed sparks pass between 1, 2 and 3, and since the system, A B, contains capacity and electric inertia, oscillations are set up in it of extreme rapidity. The line of propagation is D d, —Fig. 2—and the frequency of oscillation is probably

* Friday evening discourse delivered before the Royal Institution, June 4, 1897. We are indebted to London Engineer and L'Illustration for the engravings published herewith.

about 250 millions per second. The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A 6 in. spark coil has sufficed through 1, 2, 3, up to four miles, but for greater distances we have used a more powerful coil—one emitting sparks 20 in. long. It may also be pointed out that the distance increases with the diameter of the spheres, A and B, and it is nearly doubled by making the sphere solid instead of hollow.

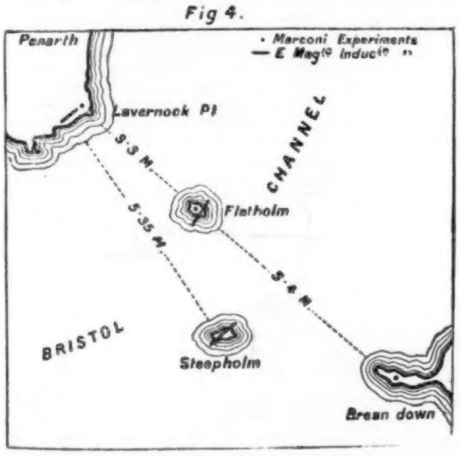
The Receiver.—Marconi's relay—see Fig. 2—consists of a small glass tube four centimeters long, into which two silver pole pieces are tightly fitted, separated from each other by about half a millimeter—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of four millimeters and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the

Fig 3



metallic powder is virtually an insulator. The particles lie higgledy-piggledy, anyhow in disorder. They lightly touch each other in an irregular method, but when electric waves fall upon them they are "polarized," order is installed. They are marshaled in serried ranks, they are subject to pressure; in fact, as Prof. Oliver Lodge expresses it, they "cohere"—electrical contact ensues, and a current passes. The electric resistance of Marconi's relay—that is, the resistance of the thin disk of loose powder—is practically infinite when it is in its normal or disordered condition. It is then, in fact, an insulator. This resistance drops sometimes to 5 ohms, when the absorption of the electric waves by it is intense. It therefore becomes a conductor. It may be that we have in the measurement of the variable resistance of this instrument a means of determining the intensity of the energy falling upon it. This variation is being investigated, both as regards the magnitude of the energy and the frequency of the incident waves. Now such electrical effects are well known. In 1866 Mr. S. A. Varley introduced a lightning protector constructed like the above tube, but made of boxwood and containing powdered carbon. It was fixed at a shunt to the instrument to be protected. It acted well, but was subject to this coherence, which rendered the cure more troublesome than the disease, and its use had to be abandoned. The same action is very common in granulated carbon microphones like Hunning's, and shaking has to be resorted to decohere the carbon particles to their normal state. Mons. E. Branly—1890—showed that copper, aluminum, and iron filings behaved in the same way. Prof. Oliver Lodge, who has done more than any one else in England to illustrate and popularize the work of Hertz and his followers, has given the name "coherer" to this form of apparatus. He has much improved it. Marconi "decoheres" by making the local current very rapidly vibrate a small hammer head against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings which, by their size, tune the receiver to the

Fig 4.



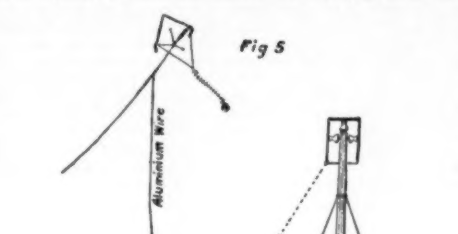
transmitter. Choking coils prevent the energy escaping. The analogy to Prof. Silvanus Thompson's wave apparatus is evident. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited, and signals made.

In open clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question, height is needed, tall masts, kites and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles—Fig. 4. I must now show the system in operation. Mirrors also assist and intensify the effects. They were used in the earlier experiments, but they have been laid aside for the present, for they are not only expensive to make, but they occupy much time in manufacture.

It is curious that hills and apparent obstructions fail to obstruct. The reason is probably the fact that the lines of force escape these hills. When the ether is entangled in matter of different degrees of inductivity the lines are curved as, in fact, they are in light. Fig. 3 shows how a hill is virtually bridged over by these lines, and consequently some electric waves fall on the relay. Weather seems to have no influence; rain, fogs, snow, and wind avail nothing. The wings shown in Fig. 2 may be removed. One pole can be connected with earth, and the other extended up to the top of the mast, or fastened to a balloon by means of a wire. The wire and balloon covered with tin foil or kite becomes the wing. In this case one pole of the transmitter must also be connected with earth. This is shown by Fig. 5. There are some apparent anomalies that have developed themselves during the experiments. Mr. Marconi finds that his relay acts even when it is placed in a perfectly closed metallic box. This is the fact that has given rise to the rumor that he can blow up an ironclad ship. This might be true if he could plant his properly tuned receiver in the magazine of an enemy's ship. Many other funny things could be done if this were possible. I remember in my childhood that Capt. Warner blew up a ship at a great distance off Brighton. How this was done was never known, for his secret died shortly afterward with him. It certainly was not by means of Marconi's relay.

The distance to which signals have been sent is remarkable. On Salisbury Plain Mr. Marconi covered a distance of four miles. In the Bristol Channel this has been extended to over eight miles, and we have by no means reached the limit. It is interesting to read the surmises of others. Half a mile was the wildest dream.* It is easy to transmit many messages in any direction at the same time. It is only necessary to tune the transmitters and receivers to the same frequency or "note." I could show this here, but we are bothered by reflection from the walls. This does not happen in open space. There are a great many practical points connected with this system that require to be thrashed out in a practical manner before it can be placed on the

Fig 5



market, but enough has been done to prove its value and to show that for shipping and lighthouse purposes it will be a great and valuable acquisition.

PRACTICAL THOUGHTS ON DIET.

By J. HOBART EGBERT, A.M., M.D., Ph.D.

THE love of personal liberty, so patent in the human family, has long been a subject of comment, not only for philosophers, but for physiologists as well. To what extent one's desires may be accepted as proper guides in life is a question which constantly engages the attention of all those who labor for the promotion of public, as well as individual, welfare. Not a few —prominent among whom will be found the naturally strong and robust and the disheartened and desperate —are wont to disregard the higher organization of man —his vast personal liberty, bounded only by conscious reason—and to advocate that man's native tendencies will, like the unerring instinct of animals, direct him aright. Thus, Montesquieu expressed the sentiment of the multitude when he stated that the health purchased by a rigorous watching of the diet is but a tedious disease. But this belief, voiced by Montesquieu and reiterated by the liberty-loving masses, embodies a fallacy of no small magnitude or mean importance. When we consider the vast and direct influence of diet upon all the functions of life, when we reflect that man's education and not an inborn instinct directs him in the selection and proper use of food, and observe how invariably the penalty of abuse and transgression here, as elsewhere, sooner or later falls upon those who disregard the laws of Nature, we are led to know that to apply to diet—as to other habits of life—the principles of physiology and those allied sciences which reveal to us the laws governing the phenomena of Nature, is not to forfeit but to confirm, and by understanding their conditions to enlarge our liberty.

To those who would have as their only guide in dietetics a vigorous, and, doubtlessly perverted, appetite, we submit for careful consideration the following lines from the pen of England's profound physiologist and celebrated surgeon, Sir Henry Thompson. In a contribution to the Nineteenth Century this astute observer writes: "I have for some years past been compelled, by facts which are constantly coming before me, to accept the conclusion that more mischief in the form of actual disease, of impaired vigor, and of shortened life, accrues to civilized man, so far as I have observed in our own country and throughout Western and Central Europe, from erroneous habits in eating than from the habitual use of alcoholic drink, considerable as I know the evil of that to be. . . . I have come to the conclusion that a proportion amounting at least to more than one-half of the disease which embitters the middle and latter part of life among the middle and upper classes of the population is due to avoidable errors in diet. Further, while such disease renders so much of life for many disappointing, unhappy, and profitless, a term of painful endurance, for not a few it shortens life considerably."

The fact that many of the dietetic laws laid down by scientists have, when applied in actual life, been shown to be inadequate, is a stumbling block to many. The reason for this is not difficult of explanation, nor does it in any way lessen the value of the truth. In attempting to lay down hard and fast dietetic laws, pseudoscience has certainly evinced its incompetence by presuming to dictate laws to Nature rather than to expound existing truths; by confounding chemical with vital processes, and by disregarding the variations of force, organic strength, and particular requirements existing in different individuals and in the same individual under varying conditions of health, occupation, and environment. True science cannot be credited with such errors, for while its votaries may grossly err in their enunciations, the fundamental truths remain unchanged. Thus, through the pedantry of those who presume to interpret Nature's laws and formulate working codes applicable to life, the evils of ignorance and indiscretion are often thrust aside only to give place to the leaden tyranny of routine. What folly, as Herbert Spencer has observed, to suppose that the whole of dietetics lies in determining whether or not bread is more nutritive than potatoes, or in similar arguments. The physiologist of to-day is far wiser than the physiologist of yesterday, in that he recognizes in human intelligence a voice which speaks from within, and which evinces in mankind as in animals natural desires which require the cultivation and rational direction of education, rather than their overthrow and the substitution of purely artificial systems and habits of life.

Man's dietetic education begins in early childhood and continues throughout life. Some never receive other education in this direction than the example of others, while some, unsatisfied with strict adherence to an established precedent, by investigation, speculation and study enlarge the boundaries of their knowledge. Charles Lamb's "Dissertation on Roast Pig" fitly illustrates this theme and also points to the existence of what it now behooves us to consider more directly—to wit, a useful and natural appetite. To utterly ignore natural desires and maintain that judgment and education alone lead to the use of food suitable for the sustenance of the body would be to turn to the other and more irrational extreme. Charles Lamb's hero, in licking his burnt fingers—injured by handling the charred and heated remains of the litter—stirred up a latent appetite for roast pig and at once set about to appease it by devouring the still smoking carcass; and the train of incidents which followed the discovery of his violation of established rules show how, by a simple chain of natural circumstances, a rigid dogma may be overthrown. Yet who will argue that too much pork is not frequently eaten by many, or deny that educational training in things dietetic has not a direct influence upon the health and longevity of the Jewish people?

While there is a general correspondence in the kinds of food which the various members of the human family enjoy, there may also be observed in individuals a special inclination for certain articles of diet and a marked antipathy for others. Thus it is found that, to a normal appetite, disrelish for any special article of food is often indicative of its inadaptation to the needs of that particular individual, while the craving for some questionable article of diet may be indicative of its value as a nutriment to the individual under the existing circumstances. In a word, appetite for food is often not only the expression of desire but of fitness as well. But, alas! it is not an invariable and unfailing guide to felicity. Does not the earliest record of human affairs contain an intimation of the perverseness of man's appetite—and that of woman as well—in the command to Adam: "But of the tree of the knowledge of good and evil thou shalt not eat of it: for in the day that thou eatest thereof thou shalt surely die." Nor does science give a perfect rule applicable to each and every case—for experience, and not theory, may alone reveal the truth. Not until we shall have gained a more definite knowledge of that subtile force which we term vitality—that force in virtue of which we exist—shall we be able to restrict with exact limitations the natural tendencies of erring man.

Admitting the function of our natural inclinations in respect to food, and granting that they indicate the existence of important relations between ourselves and our environment, which are revealed to us in no other way, it is not yet demonstrated that they are unerring guides in human life. It is physiologically shown, as well as philosophically emphasized, that with man the natural tendency of all carnal desires is to excess, and hence we can concede the fundamental government of nutrition to appetite only when appetite leads to the fulfilling of instinctive impulses by the legitimate and rational gratification of natural desires. In a word, man is called upon to employ both reason and knowledge in aiding and controlling his natural desires.

To be guided by nature implies not only that we must have natural tastes to gratify, but also that they are given due opportunity to indicate their normal preferences. By the habitual use of strongly seasoned dishes, of artificial flavors, of modes of cooking which conceal the natural taste of the substance, and even of a great variety of dishes at a meal, the appetite is daily perverted. The chief aim seems to be to please the palate rather than to satisfy the wholesome hunger of the stomach. It is true that the enjoyment of food exerts an influence in promoting the activity of digestive processes, but the relish must be real and not imaginary—general, not merely local—for the best diet gives not only temporary, but permanent and genuine satisfaction. "It is more than probable," says Dr. Hinton, "that some men lead languid and unenjoyable lives in the midst of every advantage, chiefly for want of some little article of food which nature needs, and which under a simpler regimen their tastes would decisively demand." Nor is this an extravagant idea, for there is ample proof that the importance of special portions of our food cannot be estimated merely by the value of their direct contribution to the system. The yeast is small in quantity, but it is all-important to the loaf. And there is every reason to believe that certain portions of our food act a part which may be compared to that of yeast in respect to bread. Nutrition is by no means a simple transference of so much matter into the body, but a long series of changes, in which certain elements are subservient to others. The repair of the

* "Unfortunately, at present we cannot detect the electro-magnetic waves more than 100 ft. from their source."—Trowbridge, 1897, "What is Electricity?" page 256.

"I mention forty yards, because that was one of the first out-of-door experiments, but I should think that something more like half a mile was nearer the limit of sensibility. However, this is a rash statement, not at present verified."—Oliver Lodge, 1894, "The Work of Hertz," page 18.

substance of the body by one part of the food is dependent upon forces derived from the changes which other parts undergo. No mere quantity, though ample, and every portion unexceptionable in its way, will give the true result, unless there is also present the complementary substance in due proportion to supply the needful stimulus.

To those who maintain a certain simplicity of living, who avoid the use of stimulants and narcotics, and obey the laws of health regarding exercise, fresh air, sleep, cleanliness, and general habit, great license may be allowed in matters of diet. But do such persons constitute the masses? Again, no matter how healthy a child, or how physically strong a maniac may be, we know that they are incompetent to select proper food for the nourishment of their bodies. Does this emphasize the value of instinct or of reason and education?

One thought in conclusion. What effect did a knowledge of the methods and habits of civilized men have upon the North American Indians? They easily learned the vices and excesses of civilization without comprehending the laws necessary to the maintenance not only of that civilization but of life itself under the artificial conditions which it produces, and the result is, or at least soon will be, seen in the extinction of the race.—Dietetic and Hygienic Gazette.

APPARATUS FOR ROENTGEN WORK.*

OWING to the interest aroused by Prof. Roentgen's discovery, a few words on the construction of induction coils and other pieces of apparatus in connection with the production of the X rays may not be out of place. Any person with an ordinary amount of ingenuity and some little mechanical skill can make the apparatus mentioned below, and much cheaper than it can be bought.

The first and perhaps most important point is the generation of the necessary power requisite to run the coil; this can be obtained from primary batteries, secondary batteries or accumulators, and the ordinary supply mains. Of primary batteries the most powerful is the bichromate, composed of a plate of zinc and two plates of carbon in a saturated solution of bichromate, to which is added strong sulphuric acid. This, unfortunately, has the disadvantage of falling off in strength after some time. Daniell's cell, composed of a cylinder of copper surrounded by copper sulphate, and a zinc plate in a porous pot and surrounded by zinc sulphate, is more constant, but not so powerful. Secondary batteries have the disadvantage of having to be recharged, and this can only be done at a dynamo or off the supply mains; otherwise this is a very convenient and portable form for producing the current. These must be bought, as the manufacture is of great difficulty and involves the use of large currents in the formation of the plates. The coil can also be driven off the supply mains, great care being taken to have sufficient resistance in circuit to prevent too large a current flowing through the primary and fusing the wire, and may be, the leads of the house. An alternating current can be used and slightly simplifies the construction of the coil, but an ordinary resistance cannot be used in this case. It has been shown that these results can be produced with short exposures by a coil giving a spark of about 6 inches, and the production of this I propose to describe.

The coil, as represented in Fig. 1, is composed of a bundle of iron wire, surrounded by two layers of

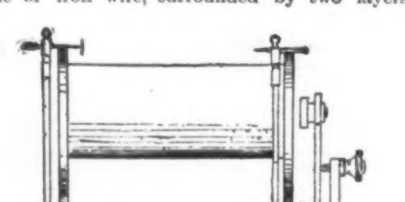


FIG. 1.

thicker wire, called the primary, which carries the inducing current; and this is again surrounded by a large number of coils of very thin wire, called the secondary, in which the high pressure is produced; a contact breaker, and a condenser. The iron core is composed of well annealed iron wire, of No. 30 B. W. G. (Birmingham wire gage), 28 Am. W. G., made into a bundle 14½ inches by 1¼ inches, made red hot in a fire and allowed to cool slowly. When cold, the whole bundle, kept together by wires round the outside, is soaked in shellac varnish or melted paraffin wax until it has penetrated right through. This is to prevent destructive currents being set up in the iron. When dry a layer of brown paper, soaked in paraffin wax, is placed round; and over the whole a thin ebonite tube. On this is wound the primary wire, composed of two layers of No. 14 B. W. G. (12 Am. W. G.) cotton covered and well soaked in paraffin wax. About two pounds of wire will be required. A layer is wound on, leaving ends long enough for making the connections, and over this a layer of paraffined brown paper, then the other layer of wire, finishing at the end at which the winding started. The primary wire will safely carry eight amperes without heating appreciably, and very likely ten could be used. Over the last layer is placed a layer of paraffined paper, and then a thin ebonite tube. On this is wound the secondary coil, which is best composed in sections—in this coil, eight. This arrangement, by placing wires having a great difference of potential away from one another, much diminishes the chance of internal sparking and thus ruining the coil. The wire is No. 36 B. W. G., 38 Am. W. G. of which twelve pounds will be required, silk covered, and the bobbins containing the wire should be soaked in paraffin wax before winding. A pound and a half of wire is wound upon each section, a former being made corresponding to a section and having one side removable, and may be driven from an ordinary sewing machine table. Fig. 2 will show the method of winding.

* By E. A. Robins, in the Photogram.

The wire is drawn through a hole near the lower part of the former, leaving enough projecting for connections, and the bobbin filled with wire, 1½ pounds. The next is wound in the same way, and the coil turned round before placing upon the core, thus, in two adjacent sections the wires run in opposite directions, as will be seen from Fig. 2; the two inner ends are

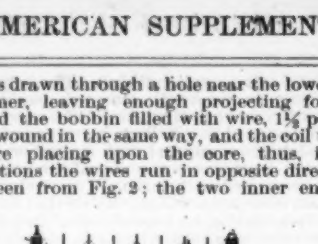


FIG. 2.

connected. The third coil is wound and placed like the first, the outer end being joined over the top of the division, with the outer end of the second coil. The fourth is like the second, and has its inner end joined to the inner end of the third, and so on, the eighth coil having one end free and is one of the terminals, the first coil being the other. The coils should be soaked in paraffin wax; the divisions may be thin ebonite of one-sixteenth to one-eighth inch thick, or of two or three thicknesses of celluloid, such as is used for the thick films, which I find very useful for this purpose. The ends may be made of ebonite or well seasoned mahogany about ¾ inch thick. Of course there is no connection between the primary and secondary. If there is, the coil is of absolutely no use. The soldering of joints between the coils should preferably be done with resin, as "killed" acid may corrode the wire and cause heating, and perhaps melting of the wire. The outside should be covered with thin sheet ebonite bent round. This prevents sparking on to the coil. The secondary terminals should be supported, about eight inches apart, on glass rods. The coil, if it is to be used with continuous currents, must have some method of making and breaking the current. The contact breaker may be composed as in Fig. 3.

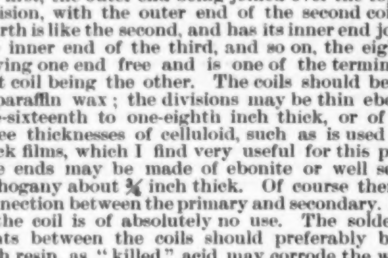


FIG. 3.

A small iron hammer, 1½ inches in diameter, supported upon a spring of brass having a screw touching against it. The points of contact should be platinum, to guard against corrosion. The hammer is opposite the end of the iron core and works thus—the current comes from the battery through the screw and spring to the primary coil and back to the battery. This makes the iron core a magnet, which attracts the soft iron hammer, dragging the spring away from the point of the screw. This breaks the current, the core ceases to be a magnet, no longer attracts the hammer, and spring flies back again, making contact. Another form of contact breaker is that shown in Fig. 4.

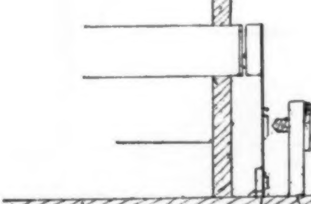


FIG. 4.

A rod is pivoted in the center, at one end of which is a platinum point dipping into mercury, on the other is a soft iron armature, below which is an electromagnet. The current from the battery flows to the mercury up the platinum point, along the rod, down the support, and round the magnet wire, through the primary, and back to the battery. This excites the magnet which attracts the armature, raising the point out of the mercury, breaking contact, current ceases and the spring pulls the rod down, again making contact. The mercury is covered with a layer of paraffin oil, to prevent sparking and also oxidation of the surface. For large coils the last named is the best, being more under control. For continuous currents a condenser is required, and is for the purpose of receiving the current induced in the primary on the break of the current by the contact breaker, which would otherwise leap across the gap between contact breaker and platinum point. The charge stored up in the condenser also assists the current in the primary wire on the make of the current. It is composed of 200 sheets of tinfoil, 9 inches by 9, having a layer of good paraffined paper between of slightly larger size than the tinfoil, the corners of alternate sheets being joined together, and each set being joined to the contact breaker as in Fig. 3, which shows the condenser in position; the condenser should, when finished, be placed under heavy pressure until the paraffin wax has set. It is most important that no connection exists between the two sets of tinfoil sheets, as this would short circuit the contact breaker and no effect would be produced upon the coil. The end of the primary should be joined to the foot of the spring in the first kind, and to the magnets in the second kind of contact breaker, the screw in the first and the mercury in the second being joined by a No. 14 B. W. G. (12 Am. W. G.) wire to a large terminal. The other end of the primary is joined to a like terminal, placed about two inches away. The wire on the magnets of Fig. 4 must be the same as the primary wire. The secondary terminals should be placed as far away as possible from the primary terminal and contact breaker, as a spark from an induction coil such as this would be very dangerous, if not fatal to some people. Sparks should not be taken to the body when above ¼ inch in length. If the current be taken from the lighting mains a variable resistance must be placed in series with the primary; enough to bring the current down to about six amperes, this being quite enough to run the coil. As this depends upon the size of the house leads, the advice of a competent electrician should be taken before attempting, or the mains may easily get fused, owing to the resistance of the primary being very small, about half ohm. If an alternating circuit be used for lighting, an ordinary resistance cannot be used, but a device known as a "choking" coil is used. This is a coil of thick wire, containing an iron core, which can be moved in or out, the farther the core is in the less the current; but, as above, advice should be taken before meddling with any electric lighting mains. A "choking" coil requires adjusting for every circuit. In the last case the condenser and contact breaker are not required, the oscillations of the alternating current having the same effect. If high frequency and potential be required, and very small current, the following device may be adopted.

One terminal of the secondary is connected to the inner coating of three half gallon Leyden jars, the outer coatings being connected to earth. The inner coatings of the jars are connected to a gap between two highly polished brass balls of an inch in diameter and about a quarter of an inch apart: the other side is connected to a coil of well insulated wire (about one pound of No. 32 B. W. G., 31 Am. W. G.) wound on an ebonite tube and well soaked in paraffin wax, the other terminal of the coil is connected to three Leyden jars, as in the first case, but with no spark gap being connected directly to the other end of the coil. Another coil of wire is wound over the first, being well insulated from it. A very high frequency of alternation is produced in the last coil, providing a continual discharge takes place across the gap (see Fig. 5). All the effects produced by

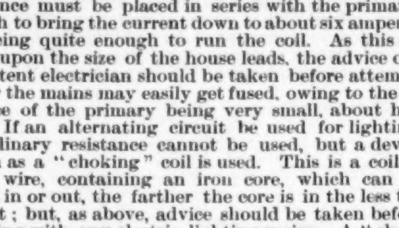


FIG. 5.

Tesla before the Institute of Electrical Engineers can be produced, on a smaller scale, of course, by the above apparatus; and it has been said the X rays are produced most readily by these means. An ordinary incandescent lamp globe, of which the filament is broken, can be used for all the above mentioned Tesla effects, but is usually not highly rarefied enough to produce Prof. Roentgen's X rays. The tubes required for this work are those first produced by Crookes, and used by him for studying his radiant matter (see Electrician, January 16, 23 and 30, 1891), and are glass bulbs having an exceeding high vacuum, much higher than the ordinary "vacuum," or Geissler tube, which is of no use for this work—at all events, without exceedingly long exposures. The connections with the interior are made by means of platinum wire fused into the glass, this metal being the only one which has about the same coefficient of expansion as glass. These electrodes, as they are called, end in the pattern of tube most used in England, in a ring of aluminum and a disk of the same metal, respectively. (See Fig. 6.) The bulb is pear-

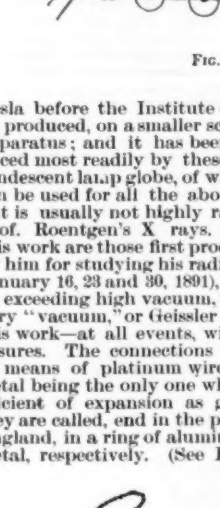


FIG. 6.

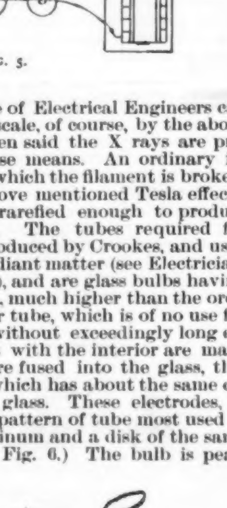


FIG. 7.

shaped, the disk suspended from the smaller end and the ring projecting from the side about three-quarters of an inch below the disk. Disk and ring are of about one inch in diameter. The generally used Continental form (which is also made in England) has no ring, only a wire projecting from the side, the disk being nearer the top of the tube. (Fig. 7.) The discharge is of a pale violet, the glass of the tube fluoresces an "apple green" tint.* The high vacuum in these tubes is obtained by means of a mercury pump, of which the Toepler is a good form, which I will describe (see Fig. 9). The diagram shows one form of the Toepler pump. In the other, the long tube, d, is replaced by a mercury valve, thus doing away with the liability of fracture of the long tube. The tube, a, has a bulb, b, of comparatively large capacity, blown at the upper end. Out of the upper end of this runs the tube, c, from which the

* The form of tube finally adopted by Prof. Roentgen himself is shown in annexed sketch, Fig. 8. It is being made by Baird & Tatlock, Cross Street, Hatton Garden, E. C., to whom we are indebted for the use of the first example made, from which to make our sketch.

air is discharged. The air enters from the tube to be exhausted by the tube, d, on to the end of which it is fastened either by fusion of the glass or else by an air-tight joint of rubber. The tube, a, is about 40 inches long to the bulb; c is about 36 inches from the level of the top of bulb; d is about 36 inches high. The reservoir, e, containing mercury is connected to the lower part of a, by means of a flexible rubber tube, and is long enough to be raised above the bulb, and contains enough mercury to fill the bulb and tube, a. The operations are: The reservoir is raised to fill the bulb, b,

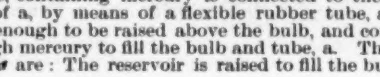


FIG. 8.

the tube is fastened on the end of d, c dipping below mercury. The reservoir is now lowered, the air rushes into b, from the tube being exhausted. The mercury has risen in c, by the pressure of the atmosphere. The reservoir is again raised, cutting off d, and forcing air out before it through c; the operation is again repeated, always driving all the air out of c, by allowing a small quantity of mercury to flow over from the bulb. If very high vacua are required, the tube to be exhausted is filled with carbon dioxide and exhausted, the residual gas being absorbed by a tube containing caustic potash being placed between the tube and a, the bulb is sealed off by a blowpipe flame before withdrawal from the pump. The extent of the vacuum can be judged approximately by the tube, c. When this stands at the barometric height, generally about 3 inches, when the reservoir is in the position of the sketch, the vacuum is fairly high. Gas is absorbed by the aluminum electrodes, is gradually given out, and will impair the completeness of the early obtained vacuum. This can be got rid of by heating the partly exhausted tube, and if an induction coil be joined to the electrodes, the extent of the vacuum can be gaged from the discharge produced in the tube. The tubes are beyond the scope of any one except an experienced glass blower, and the exhaustion is very difficult, and they are, therefore, better obtained from a manufacturer. The exhaustion generally takes a large amount of time.

To return to our coil. It may be mounted upon an ebonite or mahogany base containing a cavity in which the condenser is placed. The frequency of the dis-

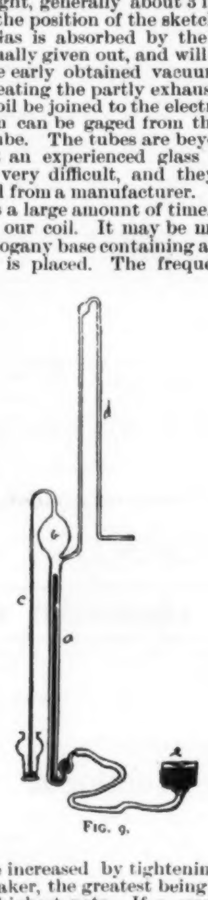


FIG. 9.

charge may be increased by tightening the screw of the contact breaker, the greatest being obtained when it is giving the highest note. If a smaller coil be required, say a two inch spark, the core should be composed of iron wire (No. 30 B.W.G., 28 Am. W. G.) treated as described above, about ten by one inches, the primary wire two layers of No. 16 B. W. G., 14 Am. W. G., double cotton covered and insulated as described above; the secondary is composed of four pounds of No. 38 B. W. G., 40 Am. W. G., wound in sections, double silk covered. A hammer contact breaker should be used for such a small coil as this. The condenser should be about 100 sheets of tinfoil, nine by seven inches.

The wire is, of course, the most expensive article, and should be obtained direct from the manufacturers. The paraffin wax can be obtained from the dealers in electrical goods. It should not be heated too high, as this slightly destroys the insulating power; it is best heated in a water bath, as paraffin wax melts at about 100° F. The weight of the six inch coil will be about twenty pounds. Shellac varnish can be used for insulating purposes, and the glass pillars of the secondary terminals should be coated with it inside and out if tube be used. Thin wires only are needed for connections to the secondary coil, as the current flowing is exceedingly small, the potential being very high.

The Leyden jars can be made of half gallon glass jars, the glass, not too thick and as white as possible, coated inside and out with tinfoil pasted on to about four inches from the top, the bare glass being coated with shellac.

A new imitation gold has been prepared by Theodor Held, Menden, Germany. It is an alloy of copper and antimony in the proportion of 100 : 6, and is prepared by mixing the antimony with the molten copper at a certain temperature. The antimony is previously cast in gold. By these precautions a malleable metal is obtained, instead of, as usual, a porous substance. The alloy has a high tenacity, and is, in fact, harder than gold itself. When finished it cannot be distinguished from the precious metal at sight, even by experts.—Uhland's Woehenschrift.

ON THE EFFECT OF MUSIC ON CAGED ANIMALS.*

By FRANK COLLINS BAKER.

SOME time ago the writer was induced to experiment upon the animals in the Zoological Garden in Lincoln Park, with respect to the effect of music upon them, and the result may be of some interest to others working on psychological lines. The experiments were made at 6 o'clock P. M., two hours after feeding, and the instrument used was a violin.

Felis concolor Linné. Puma Panther. When the music first began, two specimens of this species were resting in the back of the cage half asleep. At the first sound of the violin they started up, and could not for a time locate the sound, the writer being some distance from the cage. They showed, however, that they liked the sound, and when the player came as close as he could to the cage, they manifested their appreciation by lying down at full length and placing their heads between their paws. During this time the music had been of slow and sweet pieces, such as "Home, Sweet Home," "Annie Laurie," etc., etc. Suddenly, the player changed "Home, Sweet Home," to the "Irish Washerwoman." At this change the panthers worked their tails nervously, and twitched their ears, and as it was kept up for a time, they got up and began pacing up and down the cage. From this action the writer judged that either the jig music, being sharp and piercing, hurt their ears, or that it was distasteful. After playing several jigs of this kind the player again relapsed into soft strains, when the animals slowly settled down in their old positions.

Felis onca Linné. Jaguar. This animal behaved much as did the panthers. While the jigs were being played he acted in a very nervous manner, jumping from a shelf to the floor of the cage and back again. Soft music seemed to quiet him. As the writer was leaving the jaguar's cage, having ceased playing for the time being, the animal walked up to the corner and reached out with his paw toward the player as far as he could. Whether this action was intended to call the player back or was simply done to catch hold of him, as many animals will do if a person gets too near to the cage, the writer cannot say. It was a curious fact that when the paw was extended the claws were all retracted.

Felis leopardus Linné. Leopard. Two specimens of this species did not seem to notice the music to any extent, except at first, as a matter of curiosity.

Felis leo Linné. Lion. The lioness Juno, with her three cubs, occupied a large cage, and the player's attention was next directed to these. While the music was being played to the other animals the lioness and cubs had been listening and watching, the cubs playing about their mother's haunches. As the violinist drew near the cage the cubs scampered behind their parent, the latter greeting the player with a gentle hiss. As the music struck up a lively jig the cubs stood upon their hind legs and peeped at the player over her haunches. They appeared very curious and much puzzled, hearing these sounds for the first time. Desiring to test their appreciation, the player slowly backed away from the cage, playing all the time; as he retreated, the cubs gradually came to the front of the cage, and the mother crawled to the front and placed her two forepaws between the bars and stuck her nose through as far as she could. After retiring to the side of the hall the player again moved toward the cage, but the family did not move, nor evidence any displeasure when he came very close to them; in fact, so close that he almost touched the great paws of the lioness. As he played the soft strains of "Home, Sweet Home," the cubs and mother sat motionless, in rapt attention, the former turning their heads from side to side. A jig played very rapidly caused the cubs to prance about in a lively manner.

Felis tigris Buff. Bengal Tiger. The music had a peculiar effect on the pair of animals in this cage. The male paid absolutely no attention to it, save glancing in the direction of the player and giving a vicious snarl. The female, however, acted as though she liked it, for she jumped upon a shelf and placed her paws and nose through the bars as described under the last species. A second experiment with the male, later, when he was stretched out upon the floor of the cage, caused him simply to look at the player, twitch his ears, and viciously spit and snarl at him. The female, however, on all occasions showed that music was not distasteful to her, and that it was, on the whole, pleasing.

Hyena vulgaris Buff. Hyena. This animal is probably the most cowardly of all the mammals, and the only effect which music had upon two individuals was to cause them to retreat to the farther end of the cage and try to squeeze out between the bars. A lively jig frightened them nearly to death, and made them tremble in every limb. Strange to say, however, they did not howl or make the least noise.

Quadrumana. The Monkeys. (Genus Cynocephalus.) The monkeys evidenced great curiosity at the music, but did not seem to show either pleasure or displeasure at the sounds. A South American sooty mangabey, however, seemed to be rather pleased with the strains, particularly the jigs. This animal is of a quarrelsome disposition, and is, therefore, kept separate from the other monkeys. It was thought by Mr. Sweeney, the keeper, that the sounds might awaken a feeling of anger in him, but such was not the case. As the violinist drew away, he followed as far as his cage would allow. A spark of reason was observed in this animal. His cage is of glass all around, and in order to hear the music better he placed his ear to a crack in the door. This he did several times as the player drew near or went farther from the cage. The monkeys confined in the larger cage, also of glass, formed themselves in a broken semicircle about that part of the cage nearest the violinist, and looked at him in apparent wonder. As he moved away from them, they arose from their sitting posture with one accord and followed him along the side of the cage. This was probably simply curiosity, although the music may have given them some pleasurable sensations. On the whole, the monkeys did not show as much intelligence as might have been expected from their high position in the scale of nature.

Pilecanus fuscus Linné and P. erythrorhynchus Gm. Brown and White Pelicans. The pen containing these birds is situated next to the monkey cage, and the music was next tried upon them. The effect was somewhat startling, for they all began to jump about, flap their wings, and snap their huge beaks; this might, perhaps, be called dancing. When the violinist drew near the cage, they snapped at him with their beaks.

The other birds in the animal house paid very little attention to the music, partly, perhaps, because they were sleepy. Several varieties of parrots, herons and smaller birds were tried in turn, but without producing any results worthy of mention.

Canis latrans Say. Coyote. The last experiment tried was upon a den of coyotes in the park. When the playing began all the animals were in their holes, but the first note had hardly been struck when they came running out, and raced up and down their den until they had located the sounds. When this was done they all squatted in a semicircle about the violinist, he having approached the bars of the den as near as possible, and sat in silence listening to the music. When it ceased they ran up to the player and pawed at him through the bars, indicating as plainly as possible that they wished to hear more. When he began to play again they again silently formed in a semicircle. This experiment was tried a number of times, but always with the same result. During this time not a sound was uttered by the coyotes, but a wolf in the den adjoining howled lustily. Here, as in the other cases, soft, sweet music seemed to be better appreciated than loud, harsh music.

Besides music made up of regular pieces, all sorts of sounds were made by the violinist—screeches, piercing notes, imitations of a cat, cow, rooster crowing and pig squealing, but these did not seem to have much effect. The loud, harsh and piercing notes seemed to affect their ears, for they moved them about nervously as though the noise hurt the sensitive nerves. To sum up general impressions, slow and soft music was received, as a rule, with more signs of pleasure than the lively jigs. The females, also, seemed to pay more attention to the music, and to be more pleased with it, than were the males. The nocturnal mammals were more interested than were the diurnal birds. This was probably due to the fact that the experiment was tried after dark, when the animal house was lighted only by electricity. It was a curious and interesting fact that the whole performance was conducted without any noise other than an occasional grunt from the lions. The experiment is worthy of repetition, and should be made at different times during the day, as in the early morning and at noon, just before and after feeding, etc., to see whether or not these conditions have any effect upon the result. The writer is convinced that many interesting and valuable facts may be learned by experiments of this character.

*The American Naturalist.

SPINNING POWERS OF CERTAIN EGGS.

IT is well known that the protoplasm of many one-celled animals may flow out as excessively delicate threads of living matter that exhibit remarkable currents and contractile phenomena. Something similar to these filose "pseudopodia" is met with in certain cells of many-celled animals, as in the pigment cells of the retina, etc. In a recent paper by Gwendolen Foulke Andrews* it is claimed that the eggs of starfish and sea urchins form very much the same sort of delicate pseudopodial filaments as are produced in those one-celled animals.

These threadlike processes are "spun" out from the protoplasm of the egg in such exceedingly delicate filaments that they have escaped notice and have now been revealed only with good lenses and exceptional optic resources.

From the elevation of the egg's surface that meets the sperm a "tuft" of fine threads is spun out; the whole surface of the egg spins out fine threads to make the egg membrane; the egg spins during cleavage; it spins out the cilia that move the blastula; it spins filaments across the cleavage cavity and from one germ layer to another in the gastrula; and the polar bodies spin like the rest of the egg.

These threads spun out are flowing material that branches, anastomoses, shows currents and other phenomena very much as do the pseudopodial filaments of such one-celled animals as Gromia.

The membrane that is formed after entrance of a sperm is made in the sea urchin by the following spinning phenomena. In normal eggs of Echinus clear, homogeneous, straight, smooth filaments flow out from the egg, very close together, and all attain the same length about the same time. These filaments then seem to fuse at the tips to make a ceilinglike film that grows thicker. The space between the filaments is then filled in—in some undetermined way—and thus the membrane is completed.

In abnormal eggs the spinning is irregular and more in the form of tufts and brushes that are more readily observed.

In the starfish after such a membrane is formed the egg sends out a tuft of threads from the place where the polar bodies were formed and then ceases to spin; soon the general surface spins again, and continues to do so during cleavage. These filaments branch and anastomose; they may bend suddenly at the base and even bend over at right angles at some point in their course; they may start from the surface of the egg at various angles, even tangentially; they may run out and attach themselves to the egg membrane.

When cleavage of the egg begins the spinnings show peculiar activity near the plane where the cells will separate. As the cleavage furrow is formed, threads spin from one side to the other, so that the two cells are connected by cross filaments as fast as they are separated by the plane of cleavage. The liquid between the cells is crossed by many most delicate strands and skeins of filaments that connect the two cells.

When the two cells subsequently approach and flatten against one another, the connecting strands shorten and thicken as if contracting to draw the cells together. When pressure is applied to such cells, the connecting threads appear as if resisting separation of the cells and as if more active in drawing them together.

Later, when more cells are formed, the same pheno-

*Journal of Morphology. February, 1897, pp. 367–389.

mena are seen, and when the cleavage cavity is present it is crossed by a network of interlaced filaments spun out from the inner ends of the cells. These filaments connect adjacent cells and also the most remote cells of the blastula.

When the blastula is ready to swim, the external spinnings cease for awhile and then start again as numerous processes from the general pellicle, all becoming very long and active as the well known "cilia" that propel the blastula through the water.

In the gastrula stage both entoderm cells and ectoderm cells spin filaments that cross the blastocœle and connect all the cells. When the mesenchyme cells are formed they, too, spin many filaments that connect with the other cells and with other filaments, so that the blastocœle is traversed by a very complex network of anastomosing filaments arising from all the germ layers. These internal spinnings remain active up to the time of formation of the proctodæum, at least.

The polar bodies spin, from the first, very fine pseudopodial filaments that soon unite with the egg and with the egg membrane, as well as with filaments from the egg, so that the polar bodies are henceforth (up to the period of the late gastrula, at least) united to the egg, and to the resulting cells, by threads of living material.

The shape of the polar bodies may be changed as distorted by contraction of these filaments; and change of place of the polar bodies seems also to be due, at times, to contraction of the filaments.

In the anastomosing network that connects the egg with the polar bodies material is carried hither and thither in the currents that flow along the threads.

Eventually the polar bodies may be taken in to the blastula, through the cleavage pore, and henceforth be connected with the network spun out from the inner ends of the blastula cells and, later, with the filaments from the entoderm cells of the gastrula also.

The natural criticism that these spinning phenomena are abnormal, pathological, and hence of less wide interest, is met by the author with the statement that every precaution was taken to maintain normal conditions, and that the eggs described were from lots that formed normal larvæ, or even themselves grew into normal larvæ after the observations. Moreover, it is granted that heat, polyspermy, immaturity of the egg and adverse states of the water resulted in very profuse spinning phenomena; but these truly pathological phenomena were very different in character and easily distinguished from the less obvious phenomena believed to be undoubtedly normal.

It is thus claimed that in these normal Echinoderm eggs the protoplasm can project delicate living filaments. That these are concerned in the formation of the egg membrane. That they connect the cells during cleavage and gastrulation, so that the protoplasm is continuous throughout the larva and not separated by the cell walls.

As appearances indicate that these connecting filaments are contractile and that they aid in drawing the cells together, they may thus prove to be the basis of the so-called "cyto-tropic" movements exhibited by the blastomeres of various eggs.

Moreover, as these filaments are living bands and as material passes along them from one cell to another, the author thinks they may prove to be the means of that co-ordinating communication in the cell aggregate postulated by certain workers in the field of experimental embryology.

The polar bodies are said to spin like the cells of the egg for a long time after their formation and to remain so long in protoplasmic continuity with the other cells that there is a possibility they may not be entirely without a place in the developmental changes.

The peculiar activities of the protoplasm of these eggs, together with many general questions connected with such phenomena, will be considered in a second paper, now in press.

Though these remarkable phenomena are new to our knowledge of eggs, the reviewer would suggest that what is here seen as living filaments may have appeared to other observers as a protoplasmic envelope on the outside of the egg. Thus it may be that the very thick covering "Protoplasma mantel" figured and described by Selenka* in the Ophiurid Ophioglypha lacertosa and the much thinner "Protoplasma schicht" in the Echinid Strongylocentrotus lividus, which also enters the cleavage cavity, are really a collection of spinnings, possibly somewhat pathological. In the last named case this outer envelope of the egg has recently been emphasized by Hammar† as a connection between the cells.—The American Naturalist.

ELECTRICAL TREATMENT OF PHYLLOXERA.

VARIOUS methods have been tried for making life unpleasant for the phylloxera and saving the vineyards, which else appeared doomed, says the English Electrical Engineer. One promising method, extremely unpleasant to others as well as the phylloxera, involved the extensive application of carbon disulphide. According to L'Elettricità, in Italy, or, at any rate, in the island of Elba, they have tried electricity. The inventor, who has the un-Italian and Teutonic-looking name of Fuchs, has established at Porto Ferraio a method of killing the phylloxera on the vine by puncturing the stem with a needle, and sending a current down to the roots. The operation has to be repeated about three years in succession, and is said to cost under 50s. per acre. The action of the current is ascribed to the production of ozone, and the vitality of the plant is said to be in no way impaired by the treatment. There are no details as to voltage or current used, and it may also be added that L'Electricien some months ago stated that experiments recently made by an engineer of the Siemens & Halske Company to destroy the phylloxera on vines, by means of ozone generated by electricity, had given unfavorable results.

According to Austro-Hungarian patent law, patents may be taken from their holders for an appropriate compensation, if it be in the interest of the army, government or the public.—Stahl und Eisen.

* Studien uber Ent. Hft. 2. Wiesbaden, 1883.

† Archiv. f. Mik. Anat. March, 1896.

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